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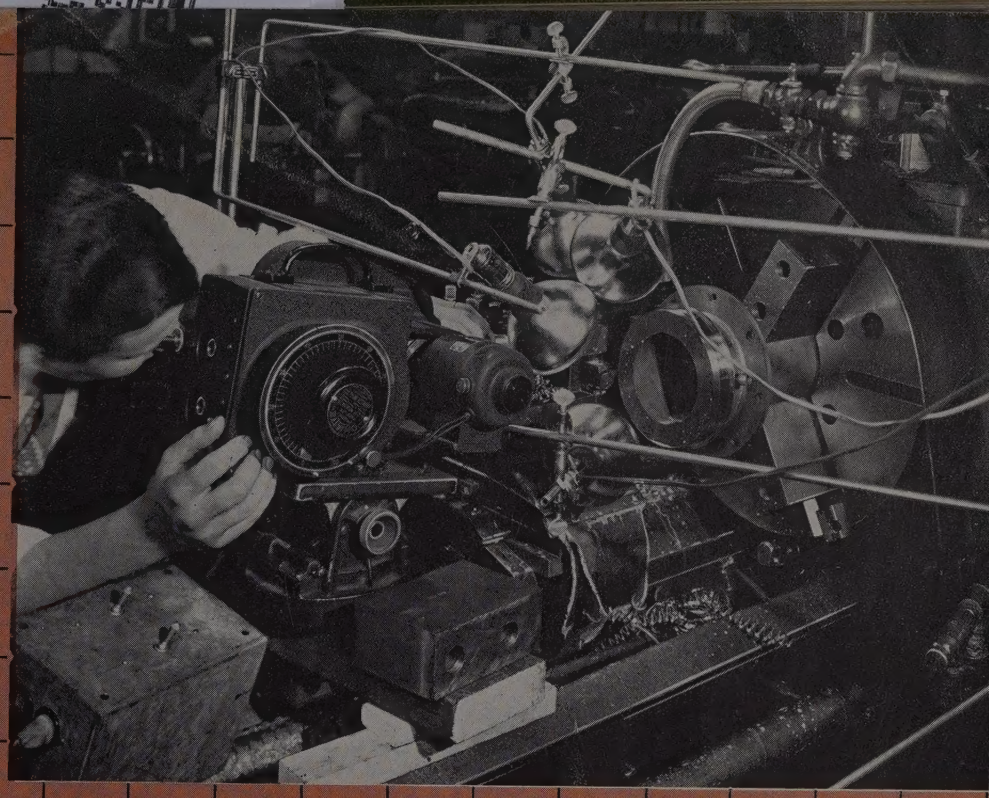

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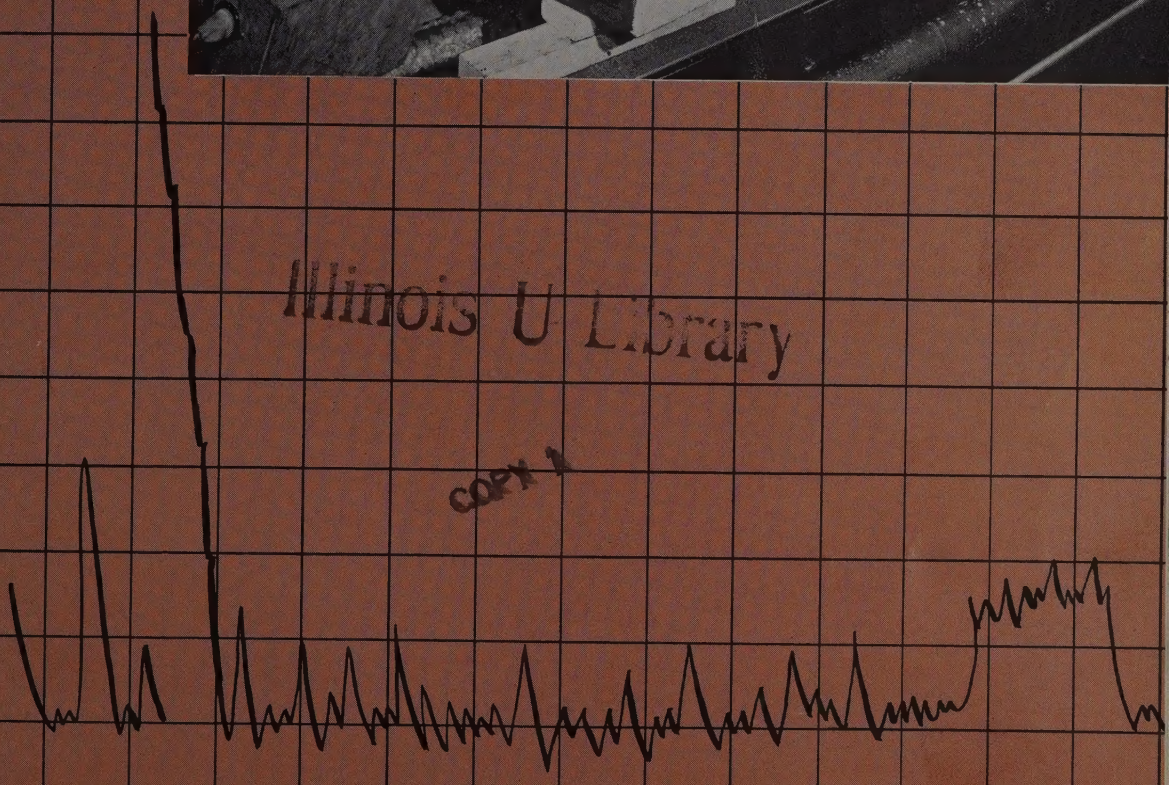

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october, 1951

Another page for **YOUR BEARING NOTEBOOK**

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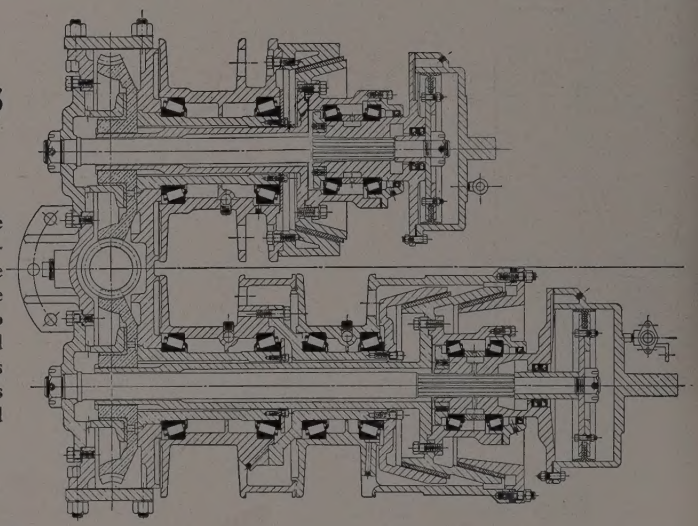

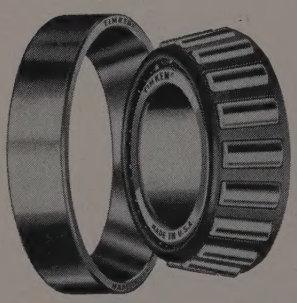

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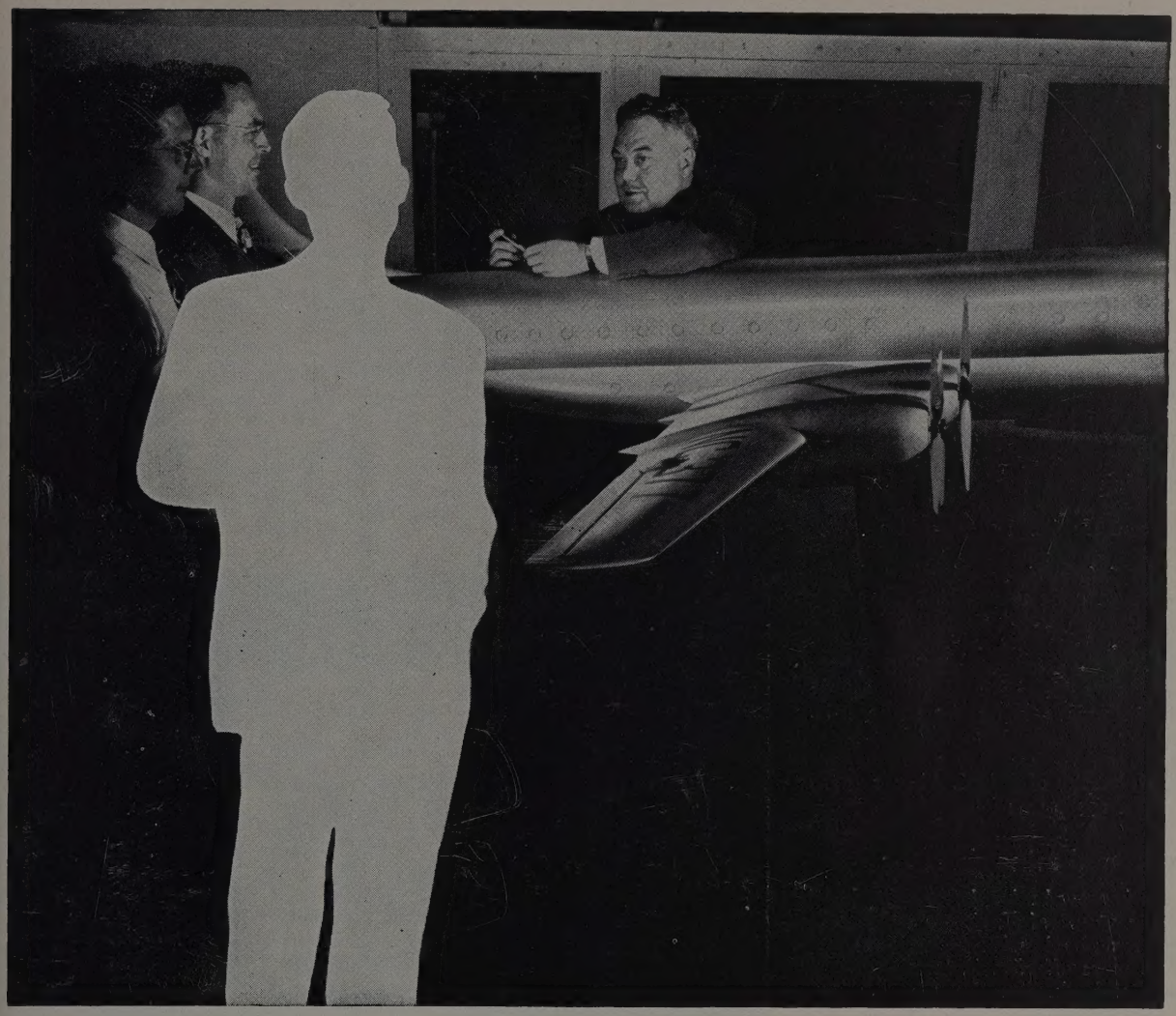

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BOEING

skimming industrial headlines

edited by Bob Hardin, e.e. '54

visual screens for aircraft

Pilots of future supersonic aircraft may watch a screen like the one pictured to know what is ahead of them and their relation to the horizon. This screen, with an optical system to project an image from ahead of the plane on it, was installed in a University of Illinois aircraft by Dr. Stanley N. Roscoe, University psychologist, for tests of how well pilots could fly with such a screen. He found they could fly very well.

The information will allow future high-speed craft to provide such a picture through television or a periscope from the front of the airplane, and to eliminate the friction-producing projecting windshield. Dr. Roscoe made tests with screens ranging from the 8-*in.* square shown, down to a 2-*in.* square. Shown on the screen are runways of the University of Illinois Airport as the airplane approaches it.

improved mine detector

An improved mine detector developed by the Corps of Engineers which will operate on land and under water should prove more effective in locating mined areas and expedite the movement of ground troops.

The new detectors will locate buried mines in any kind of soil, according to the Army. Older types are useless where magnetite or black earth is prevalent. The Army says the new detector, also able to operate under water, should prove more effective in clearing beach areas. It has been a practice to lay land mines in shallow water near beaches to intercept landing craft and troops.

The presence of a buried mine is indicated to the operator of the new and improved device by a combination of visual and auditory means. The visual meter indicates the presence of a mine, and, simultaneously, its presence is further revealed by a distinct sound in the headset worn by the operator.

new optics

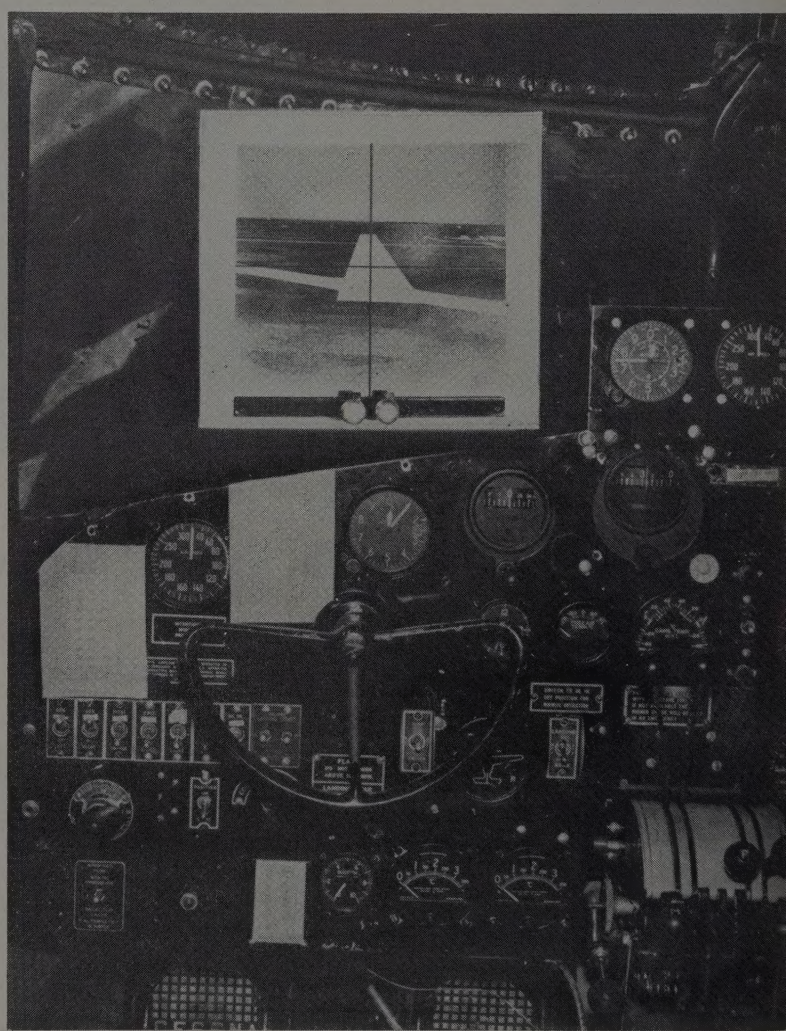
One of the most difficult jobs in the history of optical manufacture has been completed by Bausch & Lomb Optical Company for the Vatican Observatory.

The task involved production of four identical six-inch prisms, special lenses and first-surface mirrors for a spectrograph for the Vatican's Astro-Physics Laboratory that will determine the composition of stars of various magnitudes.

Made from a flint-type glass, specially selected and highly annealed, the 61-degree prisms are accurate in performance to five millionths of an inch and required nearly two years to produce. Interferometer tests, the most precise known, were used to determine the extent of each polishing operation. Fine polishing, which is done by hand, was limited to ten minutes so that heat generated by polishing did not damage the prisms. After each operation, the prisms were allowed to cool off for one hour.

The spectrograph will be used with a telescope to record light emanations of stars on sensitized photographic plates. Through its prisms, it will split light into its component colors or wavelengths, and by reference to these, the

(Continued on Page 32)



Pilots of the future may do their flying with the aid of visual screens such as the one shown here lined up on the U. of I. airport.

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Published eight times during the year (October, November, December, January, February, March, April and May) by the Illini Publishing Company. Entered as second class matter, October 30, 1920, at the post office at Urbana, Illinois, under the Act of March 3, 1879. Office 213 Engineering Hall, Urbana, Illinois. Subscriptions $1.50 per year. Single copy 25 cents. Reprint rights reserved by *The Illinois Technograph.* Publisher's Representative—Littell Murray-Barnhill, 605 North Michigan Avenue, Chicago 11, Ill. 101 Park Avenue, New York 17, New York.

the illinois technograph

volume 67 **number 1**

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our cover

This perplexing and rather confused tangle of lights, wires, camera, timer, and machinery illustrates the role that photography is playing in engineering work today.

our frontispiece

Laboratory icicles: in the 20-below-zero temperature of this refrigerated "igloo," a circuit breaker is being prepared for a high voltage test.

scientists are now fighting a . . .

cold war

by Hank Kalapaca, e.ph. '52

The coldest temperature ever recorded on the earth's surface due to Nature's handiwork was 90°F below zero. This record was set on February, 1892, in the northern Siberian village of Verkhoyansk. If someone tried to tell a low temperature physicist that 90°F below zero was cold, he'd probably scoff at him and say, "Cold—that's hot!"

Actually, the physicist would have good reason for making such a statement for his work takes him down to temperatures around –273°C (about –460°F)—just a hair's breadth from absolute zero!

Today, it is not uncommon to read an article in a magazine or newspaper about experiments being conducted to investigate the properties of matter at very low temperatures. However, such was not the case a few decades ago. It is not that scientists didn't realize the importance of such experiments, but the technical difficulties confronting them in trying to obtain and maintain very low temperatures were staggering. One not only had to be a physicist—he had to be a refrigeration engineer, too.

Most of the pioneering in the field of low temperatures took place in Europe and England. Unfortunately, it took a war to finally get the United States interested in this field. Prior to 1946, there were only two laboratories here engaged in low temperature research. Now, however, the situation has changed radically. There are low temperature laboratories all over the United States. Most of the work is being sponsored by the Office of Naval Research and the National Bureau of Standards. General Electric, however, has recently built a 250,000 dollar laboratory and there are universities extending from the Massachusetts Institute of Technology to the University of California which are also very active in this field.

There are two main reasons for this rapid development. First of all, the development of new methods of liquefaction, as a result of work undertaken for military purposes, has made the production of liquid helium no longer a major undertaking, but a relatively easy task. The other reason for the increasing interest in very low temperatures is probably due to the challenge presented by the problems which still stubbornly refuse to yield to theoretical explanation.

HANK KALAPACA

In this issue, even the editor worked. In addition to his duties on the TECH, he is a member of Phi Eta Sigma, Sigma Tau, and Air Force ROTC.

A senior in engineering physics, his hobby is hypnotism, which may explain how he continues with his activities, maintains an excellent scholastic average, and makes the TECH staff work at the same time.

One word that is heard quite frequently around low temperature laboratories is cryogenic—the first part of the word is from early Greek and means cold. Consequently, laboratories engaged in studies in the extremely low temperature range are known as cryogenic laboratories.

Concept of Temperature

Before any attempt is made to explain how very low temperatures are obtained or how they are measured, the concept of temperature has to be clearly defined.

To the man in the street, temperature is something he feels by his sense of touch. When he touches a hot object he says that the temperature is high, and that's about all he can say about it. Actually, he is witnessing the transfer of energy from the molecules of the substance to his skin. This transfer of energy could also be obtained from the radiant energy of the sun, a sun-lamp, a stove or radiator, or just from the walls of a room.

To a physics student, however, the concept of temperature would probably have a different meaning. He is accustomed to thinking of temperature as

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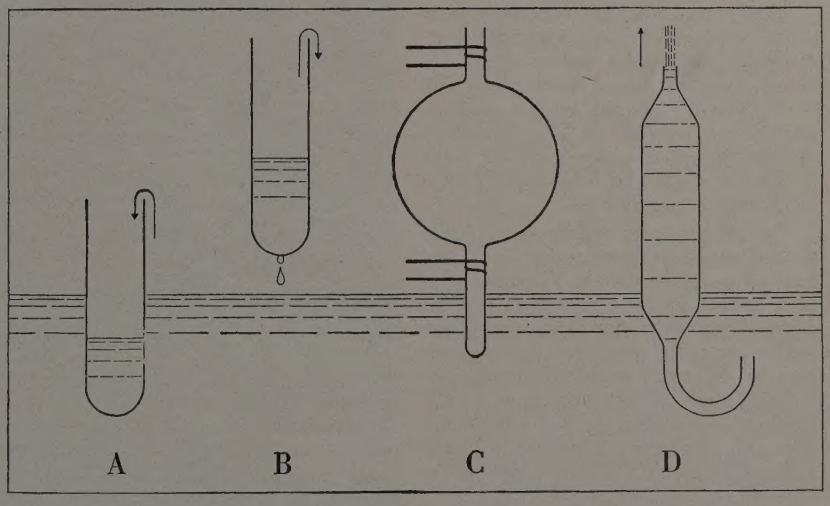
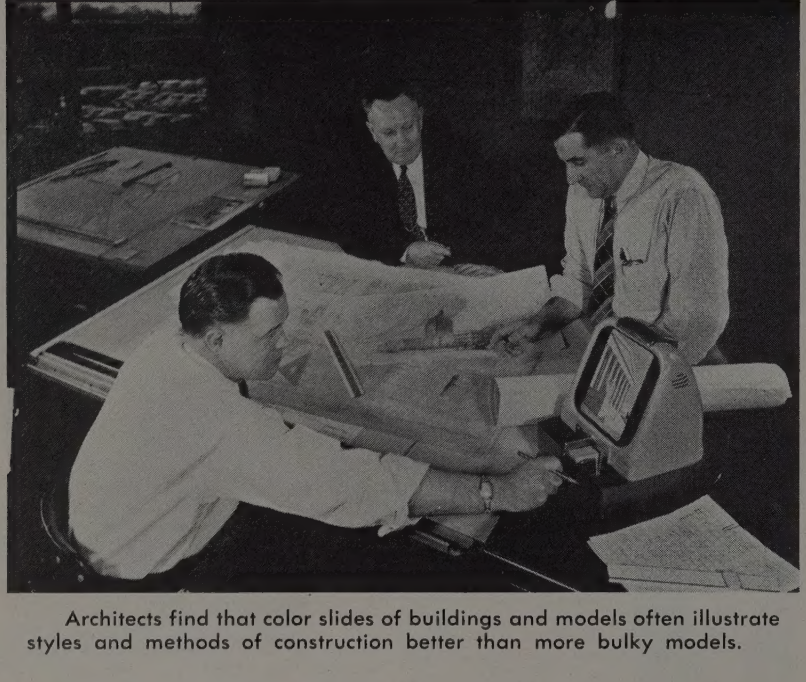


Liquid helium behaves strangely when it is cooled to 2.19°K. If a vessel is lowered into (A), the helium climbs in. If the vessel is lifted out of it (B), the helium climbs out. The speed with which this film travels may be measured by timing its arrival at the top wire on a glass bulb (C). If helium is allowed to enter a fine tube at the bottom of another vessel (D), it will spurt from the tube at the top when light is shined on it.



Architects find that color slides of buildings and models often illustrate styles and methods of construction better than more bulky models.

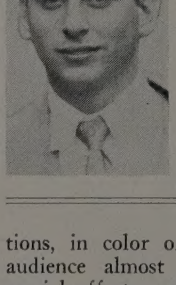
photography in engineering

by Henry Spies, ag.e. '52

"Amateur photographers are just frustrated chemists." This statement, undoubtedly made by a jealous chem. engineer, is often heard when the cache of equipment that the serious amateur possesses is unearthed. This article is to help picture-snapping engineers justify their avocation on a basis other than psychological satisfaction.

One of the most widely known jobs of the engineer-photographer is in the field of visual education. The most popular forms of visual education are the color slide and the motion picture. These media are most useful to the engineer because the usual projection equipment is much easier to transport than would-be models and demonstration equipment. The old adage that a picture is worth a thousand words was never more truer than in the field of engineering.

A simple photograph or slide will show a wealth of detail that defies verbal or written description. The role of the motion picture is even more important due to its versatility in showing a complete process with full scale operations, in color or monochrome, to an audience almost anywhere. With the special effects available in cinematography, it has rapidly become one of the most popular salesmen and demonstrators in the field of engineering.



HENRY SPIES

For his first feature article, Hank has chosen to write about a subject that he himself knows quite a bit about from actual experience. Photography has been his major hobby for the past five years.

In this article, he points out several uses of photography in engineering that the average camerist might utilize.

Besides having worked on the TECH for a year, Hank is in the advanced AFROTC and is a member of ASAE and ASCE.

Color slides are within the scope of nearly any camerist using his present equipment, or with a few additional items. This technique is readily adapted to almost any type of subject material and equipment available. Civil and mechanical engineers may start collecting slides of installations and equipment in their field of specialization that will prove invaluable in future design and research problems. Architects find that color slides of buildings and models often illustrate styles and methods of construction better than more bulky models. These and many more uses of color slides are in the possession of the photographer.

Movies for use within the organization by which they are filmed can often be made by the amateur cinematographer, using his own equipment. For films made for public showing, the professional touch of specialists usually enhances their sales value. For the engineer who wishes to present the unusual, there is the color-separation Anaglyph system of three dimensional motion pictures using standard projectors and screens. Although this process is not well known, and not the height of practicality, it is capable of producing unusual effects and adding realism to difficult subjects.

Everyone remembers the childhood game where a simple whispered statement is relayed from one person to another with a humorous distortion as the end result. This might be fun at a party, but errors in duplication are not the least bit humorous in the engineering world. When there is a need for a copy of a document such as a report, a contract, a letter, or an engineering drawing, the need is not for an approximation; the need is for an exact copy. Photocopying is the fastest, easiest, and most accurate method of documentary reproduction.

In the same category as photocopying is microfilming, a process used for reproduction in any size other than the original size to facilitate filing of large drawings and documents. The main difference between photocopying and microfilming is that no intermediate step between the original and the copy is necessary in photocopying.

Both of these processes can be easily performed by the amateur photographer. In photocopying, all that is necessary is a contact printer of sufficient size

high contrast positive paper, and proper processing chemicals and facilities. Microfilming is more efficiently done with the special equipment designed for the purpose, but it can be done with most 35*mm.* cameras that can be equipped with extension tubes or closeup lenses with few additions to the camerist's usual equipment. Larger size copy negatives may also be made with cameras which have ground glass viewfinders and double-extension bellows.

Just what happens when a force is applied to a rigid member of a machine or structure has always been of necessary interest to engineers. Both safety and economic considerations dictate this interest. Again, photography speeds up investigation and makes a normally complex task an easy one.

Perhaps the easiest method of determining stress distribution in a machine or structural section is to construct a clear plastic model of the section in question, load it exactly as the prototype is to be loaded, and illuminate it with polarized light. The result is a spectacular illustration of the stress distribution.

The stress patterns brought out by the polarized light may then be photographed in monochrome or color for a permanent record for use in design and in classroom discussion. The engineering camerist can perform this service with no more than the usual complement of equipment and facilities, although exposures may have to be determined by the trial and error method. If these stress patterns are photographed in color, the exposure must be made reasonably within the exposure for which the particular type of color film is balanced, or serious errors in color rendition are quite probable.

Other methods of stress analysis that employ photographic recordings include those using oscilligraphs, the Wheatstone bridge, and the mirror galvanometer.

One of the most widespread uses of functional photography in engineering is in the field of instrument recording. The accuracy of photographic recordings is unquestionable. It provides an enduring account of conditions at the desired precise instant with no possibility of erroneous readings of transient variables. With photographic methods, the human element is eliminated as is time-consuming checking and rechecking. The types of instruments which can be made to record photographically are almost unlimited.

Have you ever had a lab instructor doubt your data, insisting that it is impossible and perhaps implying that he thinks you dry-labbed the whole experiment? A simple photograph of your equipment and instruments when you observe inexplicable phenomena is definite proof of your ability and integrity.

Many electrical engineering and physics courses use oscilloscopes extensively in laboratory work. Can you describe adequately what you saw in class when writing your lab report? Photographic oscillograms need little explanation. The technique for obtaining useful oscillograms with the minimum of equipment is as follows: place the camera on a solid support, with the field of view including the face of the oscilloscope, feed into the instrument a wave of known shape and magnitude, and photograph it. The grid face of the oscilloscope is then removed, and the results of the experiment which appear on the face of the tube are photographed. When the prints are to be made, construct a grid

The result: the molten metal is caught in action.

on the top of the enlarging easel, using thread or similar material. The easel and enlarger are set so that the grid on the easel corresponds to the grid on the oscilloscope through the use of the negative of the known wave. The enlarger and easel are then locked in this position, and the rest of the negatives are printed with perfect correlation with what actually appeared on the oscilloscope. The use of high-contrast film and paper is recommended, although much the same result can be obtained through overdevelopment.

This particular case was cited as an example of the multitudinous uses in the field of instrument recording that are within the reach of the amateur who exercises his ingenuity.

A development that has become increasingly important in the field of engineering during recent years is the use of spectrography in the analysis of materials. Once, such studies could be made only by lengthy laboratory techniques; but by applying photography to the problem, more graphic and more easily understood data can now be obtained, and a permanent record made of them at the same time.

If the material whose composition is in doubt is burned in an arc, and the light given off directed through a ruled grid, lines will appear on a spectrum scale, characteristic of every element in the original material. When a photographic emulsion is exposed to these line images, a permanent record is obtained capable of showing even minute traces

(Continued on Page 26)

A special high speed camera records the complete welding operation of an electric arc which can later be analyzed.

the technograph tours . . .

U. of I. research

The University of Illinois has long been noted as one of the outstanding engineering schools of the country, not only for its program of undergraduate training, but also for its graduate work and for the vast amount of research that is being conducted in the different engineering departments.

Many of the major research problems being investigated at the University have been so largely publicized, they have become relatively familiar to most Tech *readers. There are numerous programs, however, that are equally important, but are less known.*

This article covers a few of these lesser known phases of research.

•

Light Flicker Research

If electric welding machines of the most popular type are causing your lights to flicker, University of Illinois engineers now know what to do about it. The data on this problem which power companies have until now been able to attack only by guess was prepared by Marvin Fisher Jr., Prof. Stanley Helm, and Prof. Max A. Faucett. They claim that electric motor loads as far as five miles away have important bearing on the effect of single-phase welders on three-phase power lines.

The University of Illinois Engineering Experiment Station has prepared a bulletin with tables from which power engineers can quickly compute the size of wires and amount of current needed to prevent objectionable flicker.

The solution was worked out in a cooperative research project of the University and the Utilities Research Commission of Chicago. The Illinois engineers worked for two years, using a mathematical and analytical approach, to solve the problem and prepare the simplified tables.

Now, they are tackling a tougher problem—three-phase welders which are becoming increasingly popular, but which with vacuum tubes in their circuits are much more complicated devices to analyze.

Lead Cable Research

Arsenic, though deadly to humans, can give longer, stronger life to underground electric cables, according to research at the Engineering Experiment Station of the University of Illinois. The idea is being adopted wholeheartedly by the electrical cable and power industries.

This is the latest finding in a 21-year project which already has brought a $100,000 a year benefit to its sponsoring agency and saved hundreds of thousands of dollars more for the whole power industry.

That amount yearly is saved by one fact alone—reported in 1935—that a copper-lead alloy for covering cables is just as satisfactory as tin-lead alloy which costs 10 per cent more.

The latest finding is that the lead for covering cables can be improved by adding a "pinch"—one-tenth of one per cent—of arsenic. This will make cables longer-lasting and allow them to carry heavier electrical loads because higher pressure can be used for the insulating oil inside the cable.

Lead cable sheaths are being studied in Arthur Newell Talbot laboratory at the University of Illinois by Prof. Curtis W. Dollins. At this moment he has 141 different specimens under test.

The University's Engineering Experiment Station has just published the sixth report from his work. It contains the findings on benefits from arsenic in the alloy. The work has not only produced direct results such as this, but also by stimulating research of cable manufacturers has brought valuable indirect results.

The project at the University started in 1929. It is sponsored by the Commonwealth Edison company of Chicago through the Utilities Research commission. In the 21 years, this has provided nearly $115,000 for the work. The one fact about tin-lead alloy saves annually nearly all that was spent in the first 20 years.

The 141 tests Professor Dollins has going on now include: two full-size cable specimens nearly a yard long being bent back and forth every 6 minutes; 19 sections of cable being given time tests with oil inside them at 25 to 40

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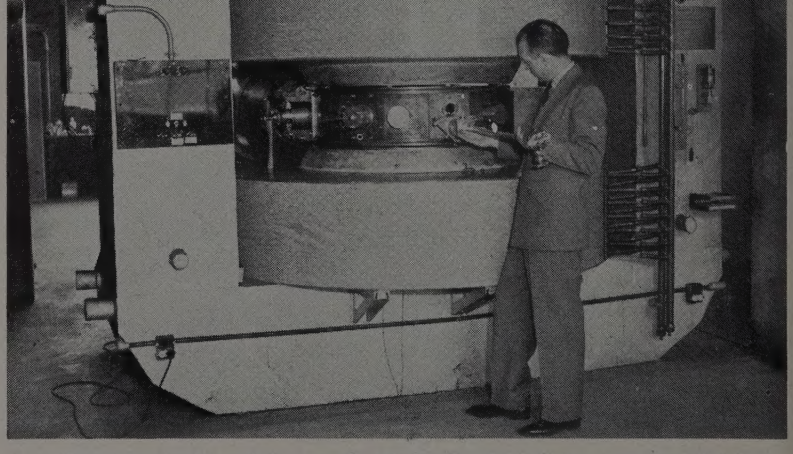


Extensive use has been made of the U. of I. cyclotron in the field of nuclear physics.

As one of their pledge duties, prospective members of Chi Epsilon are required to write a short theme on some phase of civil engineering. For the benefit of this year's pledges, the Technograph is publishing three of the themes which were submitted last semester.

"Small Town Sewage Disposal" was written by Bob Kell, "Foundation Problems in Mexico City" by Jim Tavares, and "Prictical Civil Engineering" by Jeff Newton.

chi epsilon themes

edited by Paul Hutchinson, mining e. '54

Small Town Sewage Disposal

Today in our fast moving world of chaos, one of our most perplexing problems encountered is that of small town sanitation. In Illinois alone there are numerous towns containing a population of 1500 or less, many of which contain no sanitary disposal system of any kind. This is alarming when we consider the fact that it affects the health of thousands of people, economic standards, and living conditions.

This problem has become apparent to many small towns and they have begun to study solutions to it. Just such a town is that of Norris City, Illinois, located in the eastern part of Southern Illinois near Carmi. Their need became apparent in the 1930's and they began planning and constructing a sanitary system as a PWA project in 1940 and 1941. However, before any great amount of work could be completed, PWA was abandoned due to World War II and the project could not be completed.

Early in 1949, with new officials in the city's government, it was decided to finish the project. Stockpiles of existing materials were inventoried and inspected for possible use in the finished project. Other details were attended to in rapid order so that by the latter part of 1949 the project was ready for the contractors to submit bids.

Early in June, 1950, the contractor began moving his equipment into the city. Existing sewers and manholes were located and cleaned out. Lines and grades were located by the engineer and pipe was scattered. The company's ditching machine was put into operation and pipe was laid as close to the machine as possible.

As the operation got under way, men located utilities and other obstructions ahead of the ditching machine where they were cut and replaced immediately after the machine had passed. Tile layers were protected from cave-ins by skeleton shoring which was removed after the tile was layed. Ditches were immediately backfilled with a small highlift and the street was again opened to traffic.

As the work progressed on the laying of sewer pipe, another force of men were busy at the disposal plant site. A partially completed tank was pumped dry and cleaned up in preparation for its completion. A water line was moved out of the site area without disrupting service for any length of time. Carpenters began building formwork to complete the first tank. Two ready mix concrete bins were placed and stockpiles of sand, gravel, and cement were placed in position for use at any time with a full day's requirements on hand at all times. A crane was brought in to dig the additional tanks and the work was scheduled with a view of keeping all men and equipment busy without any delay or layoffs. Concrete was poured just as soon as formwork permitted.

After the completion of the first tank, the carpenters began setting plywood forms for the construction of a 17 *ft* square control building which proved to be a most difficult construction problem, for in digging the basement of this building there appeared a stream of water of considerable size to be combatted during construction. The problem was finally solved by placing 8 to 10 *in* of gravel over the basement floor and installing a sump pump to remove the water until construction had been completed. This solution worked comparatively well for this structure. However, later on, in building a round shaped tank with a cone shaped bottom, the same streams of water was encountered at a lower depth in the cone shaped bottom. This indeed, formed a problem, for equipment was not available to the contractor for placing concrete behind the cone shaped form without excessive cost which necessitated placing the concrete bottom somewhat as a plasterer would place plastering using a vry dry mix of concrete. Water, however, complicated this procedure in that the dry mix mould absord so much water from the stream that it would slump down the sides before the concrete had a chance to set up. As a solution, it was finally suggested that the water be directed through covered channels to pipe running through the concrete to a barrel where a sump pump would remove it. The bottom was then placed as originally planned.

As this is being written, the project is still under construction. Because of unusually bad weather conditions during the construction, the project is not likely to be completed until next year's construction season. However, when it is completed, it will adequately serve the Norris City, and will improve the city in many ways.

Foundation Problems in Mexico City

Mexico City, a city of two million people, presents a good example of the difficulties encountered in constructing buildings on undependable foundation material. This city with buildings thirty stories high has been built on soft clays formed of volcanic ash that have a water content up to 500 per cent. Buildings settle many feet below the surface, or if they are on long piles, they seem to rise several feet since the surrounding ground settles as water is drained from it. These difficulties have

(Continued on Page 26)

introducing . . .

by Howard Hadler, ag.e. '54
George Ratz, c.e. '52
Tom Madden, e.ph. '54

PROF. JOHN M. COAN

Professor Coan was born in Baltimore, Maryland, on April 28, 1915. He became interested in engineering during his latter years in elementary school while observing the outside work of surveyors and construction engineers. He then went to the Baltimore Polytechnic Institute—probably the finest technical high school in the United States. This was a school attended by 3000 boys and offered courses in calculus, strength of materials, graphic statics, and thermodynamics along with the shop courses and other secondary school courses. This exceptional start enabled Prof. Coan to skip the freshman year of college and familiarized him with all subjects in the sophomore year.

From 1932 to 1938, Coan attended Johns Hopkins University where he received his B.S. Degree in civil engineering and the M.E. (M.S.) Degree, majoring in structures. Coan resumed his graduate training in 1946 at the Polytechnic Institute of Brooklyn where he received his Ph.D. in aeronautical engineering in 1948.

Prior to the resumption of his graduate work, Professor Coan worked as a stress analyst at the Glenn L. Martin Aircraft company in Baltimore from 1938 until 1942. As assistant professor of aeronautical engineering at Iowa State College from 1942 to 1946, he taught a wide range of aeronautical subjects to both civilian and military students. Coan then took an interim summer position as structures test engineer at the Douglas Aircraft corporation, Santa Monica, California, where he worked on both static and component tests. As research associate at the Polytechnic Institute of Brooklyn during the following year, he supervised a Navy-sponsored test program on fiberglass plates.

PROF. JOHN M. COAN

Professor Coan was appointed associate professor of aeronautical engineering at the University of Illinois in 1948 and promoted to full professorship in 1950. At this university he has been teaching aircraft structures, structural design, structures laboratory, and related courses—at both the graduate and undergraduate levels. He has been the faculty adviser to the student chapter of IAS for the past two years, and is the department representative on the Policy and Development Commission of the engineering college.

By his own admission, Coan is a "bookish" fellow, but he finds time, as most of us, to "play at" golf. However, most of his spare time is devoted to concerts, lectures, and extensive reading in non-technical fields such as international affairs, philosophy of education, psychology, music, art, and history. He is particularly interested in traveling in Europe where he has spent two 3-month vacations in the past 13 years. The present trend of the aviation world into the romantic areas of jet propulsion and supersonic aerodynamics has not lured the professor away from his field in the analysis and design of aircraft structures.

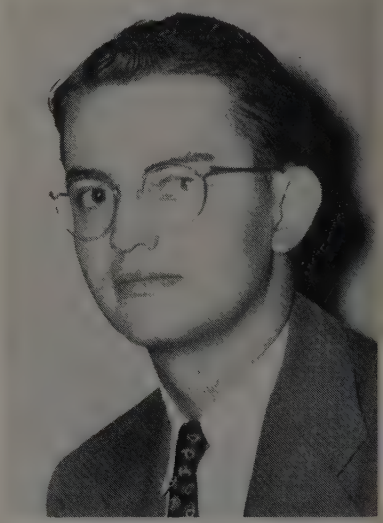
From Coan's students, the writer has learned that the professor's courses are handled in an excellent manner. However, he has never been proud of his punctuality. Perhaps this can be explained by the fact that he is a bachelor.

Coan is a member of Tau Beta Pi, Sigma Xi, the Institute of Aeronautical Sciences, the Society for Experimental Stress Analysis, the American Society for Engineering Education, and the American Association of University Professors.

DR. CHARLES P. SLICHTER

Many authorities agree that the first step toward a successful career in teaching is to gain the confidence of one's students. This being the case, Dr. C. P. Slichter of the physics department has certainly started off on the right foot, for he has been voted the most efficient instructor in that department. The most efficient instructor poll was held last May, juniors and seniors being the only students eligible to vote. To be recognized by this poll is in itself quite an honor, but to gain this recognition during one's first year of teaching upperclassmen, as Dr. Slichter did, is indeed worthy of high merit.

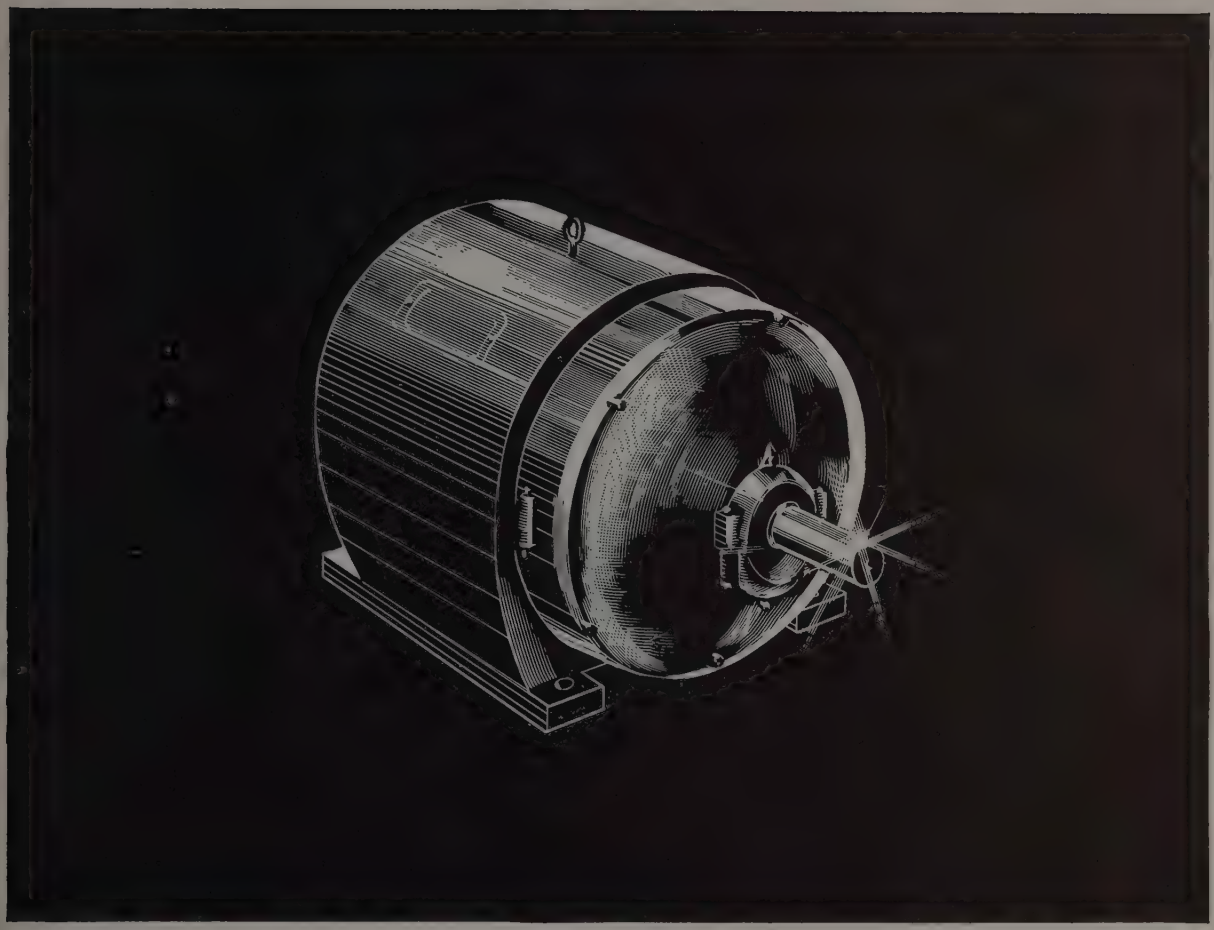
Although he was born in Ithaca, New York, Dr. Slichter calls Cambridge, Massachusetts, his home, as it was there that he spent most of his life before coming to Champaign-Urbana. A quick look at Dr. Slichter's ancestry leaves little doubt as to what his life's work should be. The son of a Harvard professor, his two grandfathers were also professors; one served in the civil engineering department here at Illinois, and the other was the dean of Wisconsin's graduate school. As if this were not enough, two of his uncles are professors at the University of California and Cambridge University.



DR. CHARLES P. SLICHTER

In 1941, Dr. Slichter entered Harvard with the class of '45 as a physics major. At Harvard, physics majors receive a great amount of electronics in their first two years. Because of this, a group of them were called during their junior year by the NDRC (National Defense Research Committee) to Woods Hole, Massachusetts, for work on a highly secret underwater explosives

(Continued on Page 30)



WORKHORSE OF INDUSTRY . . .

Its granddaddy was a ponderous bi-polar Percheron that weighed hundreds of pounds . . . and cost hundreds of dollars more for the same horsepower. Yet this little miracle of efficiency runs for years without attention . . . has only one moving part. Today, motors are being built that operate safely in dusty, dirty, even explosive atmospheres.

Many nimble minds gave their ingenious best to make these improvements possible. Physicists, chemists, metallurgists, electrical and production engineers, designers, machinists . . . these and a thousand others contributed to the breeding of this alert little workhorse of industry.

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HEADQUARTERS FOR BUSINESS INFORMATION

honorary and society news

by Chuck Wade, m.e. '52

SIGMA TAU

Sigma Tau is one of the two all-engineering scholastic honoraries at the University of Illinois. This organization has a three-fold purpose: (1) to promote engineering progress by providing incentive for and recognition of individual achievement, since progress is manifested chiefly through the advance of outstanding persons; (2) to provide training by service in Sigma Tau leadership. It is true that a person gets from any organization no more than what he puts into it. Service as an officer or committeeman developes leadership to a fine extent; (3) to offer the opportunity for the development of personal and professional friendships.

IAS

The Institute of the Aeronautical Sciences has again had a busy semester. Interesting speakers and films were the highlights of the monthly meetings.

The last meeting of the semester usually consists of two student speakers who give their seminar papers. These students are chosen from the seminar classes, one from each. They are in competition for the Annual IAS Lecture Award the night of the meeting. The winner is then chosen by the faculty and the officers of the IAS.

The IAS was one of the backers of St. Pat's Ball this year. According to the engineers, it was the best dance of the year.

The IAS has recognized the fact that the freshmen and sophomores do not come in contact with the aeronautical engineering instructor until he becomes a junior. During the past semester, the faculty has gotten together with the underclassmen on an informal basis. The purpose of the meeting was not only to introduce the faculty but also to promote interest in the IAS. It is believed that this meeting has produced good results and it is hoped that every semester will find a similar get-together.

Recently elected officers for the fall semester are William Greenfield, chairman; Loren Anderson, vice-chairman; Donald Pfeuffer, secretary-treasurer; Joe Gross, Engineering Council representative; Mr. H. H. Hilton, honorary chairman (Faculty Adviser).

Mr. Hilton has replaced Dr. Coan, who has served as faculty adviser for the past two years and who has done a very commendable job. Mr. Hilton is an instructor in aeronautical engineering and is very well liked by the students.

The yearly dues of this organization are $1.00, and for an additional fifty cents, a sharp looking pin may be obtained. Upon graduation, if the member is in good standing with the IAS, the member becomes a technical member of the parent organization.

PI TAU SIGMA

Pi Tau Sigma is the National Mechanical Engineering Honorary. Illinois Alpha, the first chapter of Pi Tau Sigma, was founded in the year 1915 by a group of upperclassmen who desired an honorary fraternity for mechanical engineers. These men accordingly formed the first chapter of an organization which would exist "to foster high ideals of the engineering profession, to stimulate interest in coordinated departmental activities, and to promote the welfare of its members."

The key to the fraternity is scholarship, but scholarship in itself is not sufficient—the men pledged to Pi Tau Sigma should participate in extracurricular activities. This participation in extracurricular activities provides the social adaptability which is so necessary to a well-rounded personality.

Such participation also affords students to become better acquainted with each other as well as the faculty. This is a very important aspect of the organization, for in a large university such as Illinois it is not an easy task to become well acquainted with those with whom you come in contact.

The Spring Initiation Banquet for 1950-1951 was held May 2, 1951, in the University YMCA. At that time, twenty-three men were brought into the organization.

The new officers for the fall semester of 1951-1952 school year are Ed Fort, president; Don Bahnfleth, vice-president; Charles Hudson, treasurer; Henry Price, recording secretary; Dick Parrill, corresponding secretary; M. M. Hammadat, council representative.

SBACS

The University of Illinois Student Branch of the American Ceramic Society (or SBACS, as it is popularly abbreviated) is the "bonding agent" of campus ceramists. Year after year the SBACS boasts that its members consist of 90-92 per cent of the students enrolled in the ceramic engineering department.

In addition to working with the Engineering Council and with other professional societies, the SBACS provides social activities and extra-curricular educational programs for its members. The highlight of the years social activities is the annual Pig Roast which is held each spring. Guest speakers from throughout the ceramic industry are invited to speak before the monthly meetings. During the year 1950-1951 the SBACS sponsored the continuation of the revival of the departmental yearbook—*The Illini Ceramist.* This yearbook is distributed to students and to alumni in all parts of the world.

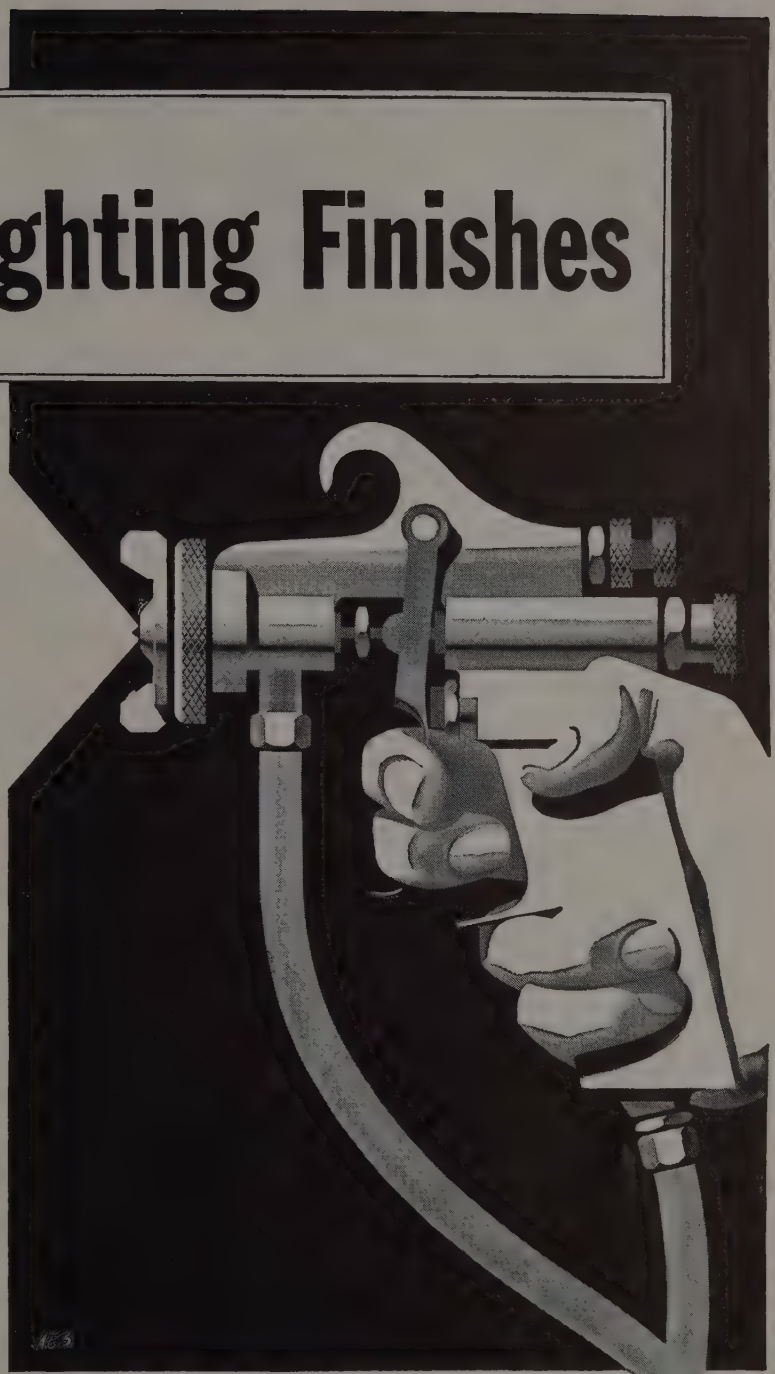
TRIANGLE

Triangle fraternity is a national social fraternity of engineers and architects. Triangle was founded here at the University of Illinois in 1907. Since then, it has expanded to 17 chapters most of them being located at every Big Ten school except Michigan State and Indiana. Although scholarship is naturally of major importance to the fraternity, Triangle tries to give its members a well-balanced college life. Participation in extracurricular activities is encouraged, and Triangle maintains a complete intramural program in almost every sport. On the social side the fraternity holds four or five dances a year, with the big dances being the Christmas Dinner Dance and the Spring Formal.

The Triangle chapter house is lo

(Continued on Page 38)

Faster Fighting Finishes



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COLLEGE MEN . . .

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HERCULES

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by Bob Schrader, m.e. '54

An engineer is a person who passes as an exacting expert on the basis of being able to turn out with prolific fortitude an infinite series of incomprehensible formulas calculated with micrometric precision from vague assumptions based on debatable figures taken from inconclusive experiments carried out with instruments of problimatical accuracy by persons of dubious character and questionable mentality for the avowed purpose of annoying and confounding a hopeless commercial group of esoteric fanatics referred to all too frequently as "practical engineers."

* * *

Flush Ye Boneyard

* * *

Doctor Rodebush of the physical chemistry department tells this one. A question on one of his tests concerned the difference between the oscillation of lead and carbon molecules at low temperatures. One of the answers to this question clearly stood out above all the rest. It read, "The frequency of osculation is much greater for diamonds."

* * *

Flush Ye Boneyard

* * *

Potentially, one of the biggest aids to the engineering freshman or sophomore is his engineering society. All the contact that most freshmen and quite a few sophomores get with engineering are a few slide rule and drawing courses. This lack of contact with engineering could be partially filled by the engineering societies. However, the fact remains that few freshmen and sophomores take an active part in their societies. Few underclassmen seem to realize that they are missing a valuable part of their education.

For the benefit of freshmen and transfer students, a list of the various engineering societies on campus follows:

The American Foundrymen's Society

American Institute of Electrical Engineers—Institute of Radio Engineers

American Institute of Chemical Engineers

American Society of Agricultural Engineers

American Society of Civil Engineers

American Society of Mechanical Engineers

Institute of the Aeronautical Sciences

Illumniating Engineering Society

Institute of Traffic Engineers

Mineral Industries Society

Society of Automotive Engineers

Student Branch of the American Ceramic Society.

* * *

Flush Ye Boneyard

* * *

In the May issue of the *Technograph,* the *Bilge* printed a list of different engineering curricula and the number of students in them. But, we made a terrible omission. We forgot the engineering physics curriculum. Our apology goes out to the eighty-some engineers in engineering physics here on campus. Also, a special apology goes to editor Hank Kalapaca, who also happens to be in engineering physics.

* * *

Flush Ye Boneyard

* * *

"Girls, if you want to be happily married, pick out a chemical engineer. If possible, get one between 28 and 30, who goes to church and Sunday school and has plenty of friends, although not too many of the opposite sex. If you can't find a chemical engineer, next best choice is a minister or college professor. But don't marry a traveling salesman or a mechanic unless you want to run the risk of being only half as happy or maybe five times as unhappy."

No, this isn't an excerpt from an "advice to the lovelorn" column. It is a conclusion based on nine years of scientific research, as presented in the book, *Predicting Success or Failure in Marriage.* A survey was made of the marriage happiness rating for 60 different occupations, and chem engineers came out on top. Now, let's hear what the other branches of engineering have to say on this.

—Stolen from the Texas A. & M. Engineer.

* * *

Flush Ye Boneyard

* * *

Sad is the lot of the student: How about the ME who was accused of cheating in a tough hour exam simply because he had broken his watch and kept looking over at the man next to him just to see how much time he had left?

* * *

Flush Ye Boneyard

* * *

And then there was the engineer who called his girl the indefinite integral because she had no limit.

—The Cornell Engineer.

* * *

Flush Ye Boneyard

* * *

Lives there an engineer with soul
so dead
Who never to himself has said
To hell with these studies
I'm going to bed.

—Kansas State Engineer

* * *

Flush Ye Boneyard

* * *

When an eastern firm received word that one of its salesmen had been found dead in San Francisco, it wired:

"Send samples back by freight and search the body for orders."

THE DU PONT DIGEST

M.E.'s AT DU PONT

Diversity of chemical products spells opportunity for the mechanical engineer

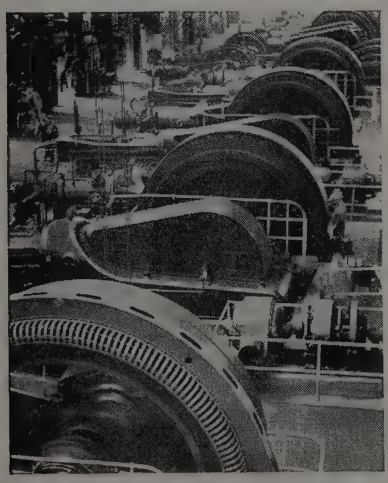
Students of mechanical engineering sometimes assume there is little opportunity for them in the chemical industry. In fields where products are made in more or less standardized equipment, this may be so.

But in a company like Du Pont which operates in many fields of industrial chemistry—where products are made at pressures over 15,000 pounds per square inch as well as in vacua low as two millimeters of mercury—mechanical engineers are in heavy demand.

What jobs do they fill at Du Pont? Literally hundreds, not including the normal run of mechanical engineering work such as design of standard equipment, scaling up from blueprints, etc.

For example, here are some of the problems encountered in the manufacture of nylon yarn alone:

1. Nylon polymer, a poor thermal conductor, is melted by a contact surface grid at 550°F. The polymer decomposes slowly at this temperature, and there is a major heat-transfer problem. Many types of melting grids had to be designed before one proved satisfactory.



The compression *stages of these 50 ton/day hypercompressors (15,000 p.s.i.) for nitrogen, hydrogen, etc., were designed by Du Pont mechanical engineers.*

2. The molten polymer is pumped to spinnerets under pressures over 1000 pounds per square inch. With nylon as the only lubricant, the pumps must operate continuously at 550°F. Specialized problems in sealing, gasketing and materials of construction are inherent in this operation.

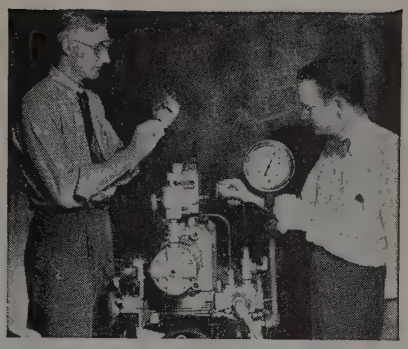
3. The melt is forced through multiple holes (diameters of 7 to 22 thousandths of an inch) in a special alloy disc. They must be made to conform to "jeweler's specifications."

4. The emerging fibers are cooled in a specially designed "air conditioned" chimney. Precise control is essential in this critical operation.

5. The fibers are wound on spools at surface speeds around 1000 yards per minute. Design calls for constant change in speed so that there is no localized stretching or relaxation of the fiber.

6. Finally, the fiber is drawn about 400% and wound on spools traveling at 5000 feet per minute. Bearing lubrication and dynamic balance presented important design problems.

These are but a small part of the mechanical engineering problems arising in the manufacture of a single product by only one of Du Pont's ten manufacturing departments. Literally hundreds of other products, ranging all the way from cellulose sponges to metals like titanium, present similar challenges. So long as new processes continue to be sought and old processes improved, there will be important work for the hand and mind of the mechanical engineer.



Ralph C. Grubb, *B.S.M.E., Tennessee '51, and Paul D. Kohl, B.S.M.E., Purdue '46, study characteristics of a super-pressure pump (75,000 p.s.i.) designed by Du Pont engineers and made in Du Pont shops.*

Heat-transfer *problems in the design of new fiber-spinning equipment are investigated by J. C. Whitmore, B.S.M.E., Virginia '44, M.S.M.E., Delaware '49, and L.B. Collat, B.S.M.E., Georgia Tech '50.*

Uniquely designed *adapter for a screw extruder under study by Ralph J. Covell, B.S. M.E., Purdue '49, and John F. Bowling, B.S.M.E., Purdue '41. The adapter heats, filters and forms polymer into filaments.*

Send for your copy of "The Du Pont Company and The College Graduate." Describes opportunities for men and women with many types of training. Explains how individual ability is recognized and rewarded under Du Pont plan of organization. Address: 2521 Nemours Building, Wilmington, Delaware.

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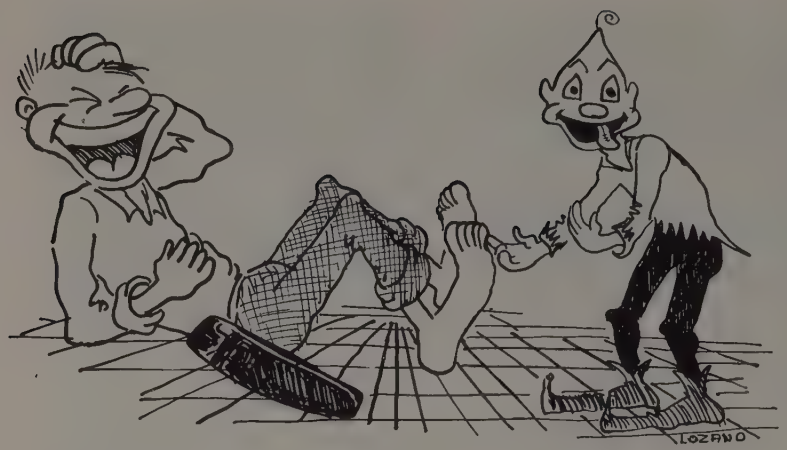


TECHNOCRACKS

I had twelve bottles of whiskey in the cellar and my wife told me to empty the contents of each bottle down the sink—or else. I proceeded to do the unpleasant task.

I withdrew the cork from the first bottle and poured the contents down the sink, with the exception of one glass which I drank. I extracted the cork from the second bottle and did likewise, with the exception of one glass which I drank. I withdrew the cork from the third bottle and poured the contents down the sink with exception of the glass which I drank.

I pulled the cork from the fourth sink and poured the bottle down the glass which I drank. I pulled the bottle from the cork of the next and drank one sink of it out, and threw the rest down the glass. I pulled the sink out of the next glass and poured the cork from the bottle. Then I corked the sink with the glass, bottled the drink and drank the pour. When I had everything emptied, I steadied the house with one hand, counted the bottles, corks, glasses and sinks with the other one, which were twenty-nine and as the house came by I counted them again, I finally had all the houses and one bottle which I drank.

I'm not under the alcofluence of incohol, but some thinkle peep I am. I'm not half as thunk as you might drink. But I fool so feelish—I don't know who is me and the drunker I stand here the longer I get.

* * *

Student: "Could you help me with this problem?"

Professor: "I could, but I don't think it would be quite right."

Student: "Well, take a shot at it anyway."

Tom Harris: "What's the matter with your fingers?"

Tony Babykin: "Oh, I was downtown getting some cigarettes yesterday and some clumsy fool stepped on my hand."

* * *

"Porter, get me another glass of ice water."

"Sorry suh, but if I takes any mo' ice, dat corpse in de baggage car ain't gonna keep."

* * *

Little Audrey, mad as hell,
Pushed her sister in the well.
Said her mother drawing water,
"Gee, it's hard to raise a daughter."

* * *

Customer: "Barber, have you got another razor?"

Barber: "Sure I have. Why?"

Customer: "I'd like to defend myself."

* * *

All those who think that "evening" means the same thing as "night" should note the effect that it has on a gown.

* * *

Waiter: Why are you washing your spoon in the fingerbowl?

Customer: So I won't get egg all over my pocket.

* * *

"Who was that lady I saw you with last night?"

"That was my brother; he just walks that way."

A grave digger, absorbed in his thoughts, dug the grave so deep he couldn't get out.

Came nightfall and the evening chill, his predicament became more and more uncomfortable. He shouted for help and at last attracted the attention of a drunk.

"Get me out of here," he shouted. "I'm cold."

The drunk looked into the grave, and finally distinguished the form of the uncomfortable grave digger.

"No wonder you're cold," he said. "You haven't any dirt on you."

* * *

Lawyer: "What if a man IS on his hands and knees in the middle of the road? That doesn't prove he's drunk!"

Policeman: "No, sir, it doesn't. But this one was trying to roll up the yellow traffic stripe."

* * *

A drunk in the Empire State Building stepped into an elevator shaft and dropped thirty stories to the basement. When he landed, he shook his fist and remarked, "I shaid up, not down!"

* * *

The ME instructor held the chisel against the rusted bolt. He looked at the ME student and said, "When I nod my head you hit it."

They're burying him at noon today.

* * *

"Waiter," said a testy patron. "I must say I don't like all the flies in this dining room."

"Tell me which ones you don't like," said the conciliatory waiter, "and I'll chase them out for you."

* * *

She: "Don't you wish you were a barefoot boy again?"

He: "Not me, lady, I work on a turkey farm."

* * *

"Say, do you know an easy way to find out the horsepower of a car?"

"No. How?"

"Lift the hood and count the plugs."

* * *

As he felt his way around the lamp post, the overloaded senior muttered, "S'no use, I'm walled in."

* * *

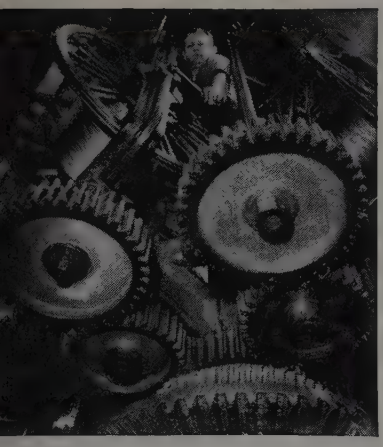
Pat: "How did Brother Jones die?"

Mike: "He fell through a scaffolding."

Pat: "What was he doing up there?"

Mike: "Being hanged."

o well...



LS WITHIN WHEELS. Here you are looking the driving gears of a 10-ton vertical ng machine, making U·S·S TIGER BRAND ator Rope to lift and lower the elevators any of our country's famous skyscrapers. equipment also manufactures general ing rope for applications such as the es shown in illustration at right. Whether need enormous steel cables to support a ge, or wire that's finer than a human hair, ed States Steel manufactures a wire d to your special requirements.

T SHEEPSFOOT ROLLER. Army Engineers this odd-looking, 36-ton steel roller a useful tool for compacting and leveling ill in the construction of airstrips. Al- gh the defense program will require in- sing amounts of steel, the constantly- nding steel-producing facilities of United es Steel should enable it to supply steel nany essential everyday uses, too.

HOW TO SWING A STEEPLE 80 FEET UP. Here are two cranes completing the 80-foot lift of a prefabricated steel steeple, and about to swing it over its base. United States Steel has won a world-wide reputation as fabricators and erectors of steel work for everything from football stadia to church steeples, from bridges to television towers.

FACTS YOU SHOULD KNOW ABOUT STEEL

In 1951, the American steel industry must be able to purchase 30 million tons of high grade scrap *outside* the industry, if it is to achieve the record steel production goals set for it by our defense program. Memo to manufacturers, farmers and proprietors of auto "graveyards": Turn in your scrap! It means money for you, more steel for America!

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NITED STATES STEEL

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COLD WAR . . .

(Continued from Page 9)

something which is proportional to the average kinetic energy of the particles in a given volume of a substance, a gas being the simplest case.

One point that must be emphasized is that the numbers associated with different temperatures are completely arbitrary. For example, on the Centigrade scale the boiling point temperature of water at standard conditions is 100, and the freezing point is 0. These temperatures, however, could have been reversed without altering the concept of temperature the least bit. This fact should not be surprising since most of our scientific measuring standards (liter, meter) are completely arbitrary units.

Early Research

The study of low temperature phenomena has a comparatively short history. In 1714, Gabriel Fahrenheit, a German scientist, achieved with a mixture of ice and salt what he thought was the lowest possible temperature. He called this point zero and used it as a basis for a temperature scale—the Fahrenheit scale.

Obviously, Mr. Fahrenheit didn't get around much, for it was soon discovered that Nature herself produced temperatures lower than the so-called zero point. Consequently, he had to introduce minus signs into his newly formed temperature scale. It wasn't until 1848 that a really suitable temperature scale for low temperature study was developed. In that year, Lord Kelvin, an English scientist, proposed his "absolute" scale. This scale has the same divisions as the Centigrade scale except that it starts with absolute zero as the lowest point, and works its way up.

The initial interest in very low temperatures was created chiefly by the desire to liquefy the so-called permanent gases such as nitrogen, oxygen, hydrogen, and helium. Helium, the last to yield, was liquefied in 1908 by a Dutch scientist at a temperature of –270°C.

Attaining Low Temperatures

Methods and apparatus for securing refrigeration at very low temperatures have received a large fraction of the scientific effort expended in this field up to the present time.

There are three important physical principles used in the production of low temperatures: (1) the dependance of the internal energy of a system upon its temperature and its volume; (2) performance of external work during an expansion, when the system exerts pressure upon a moving boundary; and (3) performance of external work during demagnetization, when the system returns energy to the magnetizing agent.

When a body of gas is compressed adiabatically, that is, without exchange of heat with the surroundings—it becomes hot. This is so mostly because of the work expended upon it, but also by virtue of the fact that the specific internal energy of a dense gas is less than that of the same gas in expanded form. Likewise, when a flask of compressed air is opened to the atmosphere and the pressure allowed to equalize, the air remaining in the flask will be quite cold. Those readers who are familiar with carbon dioxide cartridges will quickly verify this fact. The gas becomes cold principally because of the external work performed in pushing back the atmosphere and in accelerating the fraction of the air which was ejected.

If one wishes to supply refrigeration continuously, a cyclic process must be substituted for the intermittent charge and discharge of the free-expansion method of cooling.

The free-expansion method of cooling worked fine down to about one degree above absolute zero. At this point, however, this method became highly impractical. Scientists were puzzled for a long time as to how they could reduce the temperature of a substance below 1°A (absolute). Finally, a scientist by the name of Giauque solved the puzzle. He postulated that since external work is done upon a substance when it is magnetized, there should be a rise of temperature when the process is carried out adiabatically, and a corresponding fall in temperature on demagnetization. The basic idea was simple: magnetize the proper chemical, and—while keeping it magnetized—cool it down to the lowest temperature obtainable. Then, demagnetize it. Cooling by adiabatic demagnetization has thus opened up a temperature range not attainable by older methods. The chief deficiency of this method is the fact that the low temperature reached is a transient condition. The cold salt begins to grow warmer immediately.

The method of demagnetizing the atoms of a substance (usually a paramagnetic salt) works fine to about .002°A. At this point, scientists use the magnetic properties of atomic nuclei. When certain materials (such as lithium fluoride) are placed in a strong magnetic field, the nuclei of their atoms line up. This method promises to yield a temperature only one-millionth of a degree above absolute zero.

To understand how difficult it is to set up some of these very low temperature experiments, one has only to look at a report of one of Giauque's recent ordeals. He and his assistants started one experiment at 7 o'clock Saturday morning and ended at 6 o'clock on the following Monday afternoon. They did not sleep or even stop to eat.

Measuring Low Temperatures

The preparation of suitable temperature-measuring devices for use at low

(Continued on Page 34)

Creeping film appears as a tiny luminous drop on the curved bottom of a vessel filled with liquid helium.

Electron tubes are the nerve ends of military intelligence—in systems set up and maintained by RCA Service Company field engineers.

Electron Tube with a military mind

With the rapid advance of airplanes, tanks, fast ships, and mechanized weapons of war, a swift, sure means of *communication* and *detection* is as important as are the new weapons themselves. It is provided—by electron tubes and electronics.

So important is this area of military intelligence that RCA Service field engineers have lifted their efforts to new peaks. Working with our Armed Forces, they install and maintain such *communications systems* as shortwave radio and portable radiotelephones. They work with systems of *detection*, such as radar. They help ships and planes *navigate* with loran and shoran. These engineers are the link between research developments made at RCA Laboratories—and America's military strength.

The number of RCA field engineers has *tripled* since World War II. And they serve where needed, wherever an electron tube's "military mind" can be of military use.

* * *

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Write today to College Relations Division, RCA Victor, Camden, New Jersey.
Also many opportunities for Mechanical and Chemical Engineers and Physicists.

RADIO CORPORATION of AMERICA
World Leader in Radio—First in Television

PHOTOGRAPHY . . .

(Continued from Page 11)

of a material not detectable by any other means.

The essential details in carrying out such a spectrographic analysis are so much less complex than the conventional chemical one that standard production and material receiving analysis can be effected without costly delay.

The average camerist would not have sufficient equipment to perform a spectrographic analysis of the type described, but his necessary knowledge of light and optical principles would serve as an excellent background for the use of this technique. The special emulsions available for this field of photography are many and complex, rendering the usual camera almost useless except for extremely simple and rough methods of analysis.

Photomicrography has become one of the metallurgist's most useful tools. The grain structure of metals, for example, is an indication of the uses to which these metals can be put. Machinability, hardness, strength, and even the approximately chemical composition of the sample are all revealed by a photomicrograph.

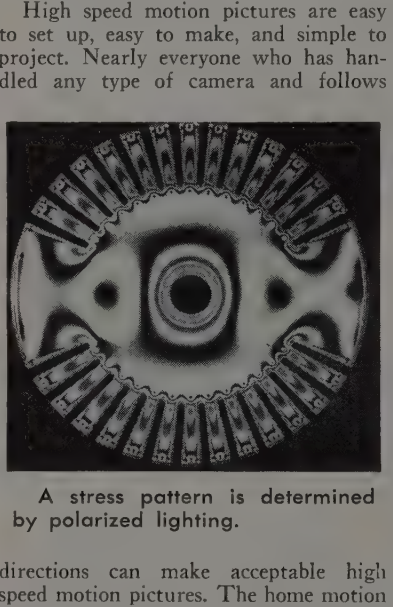
Many diverse industries use photomicrography as a basic tool in their manufacturing and research departments. The molding of plastics, the durability and weather-resistance of paints and varnishes, the strength of building materials, and the usefulness of a wide variety of other products have been and are being improved by including photomicrography with other basic methods. This function of photography should not be regarded as a research tool only. It is equally valuable in the production, design, and inspection of a great variety of products.

The engineer who owns one of the many miniature cameras that will accept extension tubes and microscope adapters can use it very effectively on many occasions for the close scrutiny of engineering materials. The main difference that he will have to consider is that the exposures in this phase of photography are measured in minutes instead of seconds. With a little time and patience, however, good photomicrographs can be made with this type of miniature camera.

What the microscope has done to aid in the examination of objects too small for the unaided eye, high speed motion pictures are doing to slow down action time of objects whose motion is too fast for investigation. It has become a valuable tool in the fields of thermodynamics, mechanics, and other studies in the research which precedes the development or improvement of a product or process. For example, high speed motion pictures have proved extremely valuable in investigations on the flow and mixing of fluids, elasticity studies on rubber, research on fuel injection and combustion, the behavior of explosive chemical mixtures—in fact, wherever motion exists that is too fast for the human eye to analyze.

Essentially the camera for high speed motion pictures is similar to the one used in the home. However, where the home camera exposes 16 frames per second, the high speed camera exposes up to 10,000 frames per second. When this film is projected at the normal speed of 16 frames per second, the elapsed time of one second can be stretched to more than ten minutes. And being on film, the record can be viewed as often as desired, and by as many people as necessary. Time magnification, through the application of functional photography, has become a new tool for the engineers of every industry.

High speed motion pictures are easy to set up, easy to make, and simple to project. Nearly everyone who has handled any type of camera and follows



A stress pattern is determined by polarized lighting.

directions can make acceptable high speed motion pictures. The home motion picture camera with the slow motion speeds of 64 frames per second may be used for slowly moving objects, but a special camera is a prerequisite to true high speed motion pictures.

This article has listed and partially explained relatively few of the uses of functional photography that should interest the engineer, and that he is capable of performing and understanding. However, I hope that it has provided food for thought for my fellow camera-snapping engineers, and perhaps suggested a few new ways to "snow" your favorite instructor.

E.E. (on phone): "Hello, is Gertie in?"

Voice: "She's taking a bath."

E.E.: "Sorry, I have the wrong number."

THEMES . . .

(Continued from Page 13)

been met in a number of ways—short piles compensating for excavation, spread footings, mat foundations, and long piles to dependable deep strata.

Surrounded by mountains, Mexico City lies on a plateau at an altitude of about 7400 *ft* above sea level. Originally the plateau had no outlet through which the rain water could escape. The only loss of water was by evaporation with the result that a lawe was formed, the bed of which gradually rose. Excavations have been carried to nearly 2,000 *ft* and the solid rock on which the first sediments were depositied has not been found. Some fair bearing material exists at 112,230 *ft* and it is this depth that must be studied for foundations for tall buildings. A geologic profile taken in the center of the city shows clay strata interrupted by thin layers of volcanic sand. Since there is a definite lack of uniformity in geological profiles taken in different parts of the city, conditions at the site of every building must be thoroughly investigated.

There are two types of ground settlements in the city—a general subsidence of the whole area, and settlements due to local causes. The general subsidence first started about 1790 when the plateau was first drained. Local settlements are caused by the weight placed on the soil by buildings or other structures. The clay under the city, although very compressible, behaves elastically up to a certain point; when the stresses of the soil are released, heaving takes place. Drying causes a very large volume change.

Early builders in the city tried to avoid differential settlement and cracking by the use of short piles under the masonry footings. However, whatever resistance there was to differential settlement was provided by the strength of the masonry foundation. In later foundations a wooden grill was built on top of the piles for the support of some buildings. In more recent times, steel grillages have been used.

With the development of reinforced concrete an excellent material was made available for the construction of mat foundations. Part of the weight of the building can be compensated for by the weight of the excavated soil. In the design of a foundation care should be taken to have the center of gravity of the load coincide with the center of the foundation area so as to produce a uniform stress on the soil and therefore, even settlement.

Long wooden piles have been used to transmit the load to sand lenses about 112 *ft* below the ground surface. Since wood piles this long are scarce, sections

(Continued on Page 28)

HERBERT J. RASS

ENGINEER—in charge of OPPORTUNITIES

by HERBERT J. RASS, *Manager, Employment Department*
ALLIS-CHALMERS MANUFACTURING COMPANY (*Graduate Training Course 1942*)

MAYBE that's a far-fetched way of putting it—but I am an engineer (Marquette 1941, Electrical Engineering) and a great many men do pass through the Employment Department to opportunities with Allis-Chalmers. I did the same thing myself.

During my last two years at Marquette in Milwaukee I worked as a cooperative student at Allis-Chalmers on the electrical test floor, in electrical product departments on both design and application work, and in the shops. When I graduated, I continued in the Graduate Training Course, on training location with what is now the Employe Relations Department. After six months—opportunity came around to look me up. The Company officer in charge of Industrial Relations talked to me about personnel work and asked if I'd like to go on with it as a career.

Liked Working With People

By that time I'd seen a lot of the Company, both product design and manufacturing, and I knew I liked working with people better than with machines, so it was just the break I wanted. During the war I was in the shops on personnel work, got a thorough grounding on operations carried on throughout the plant, and made many contacts. In 1950 I was made manager of the Employment Office.

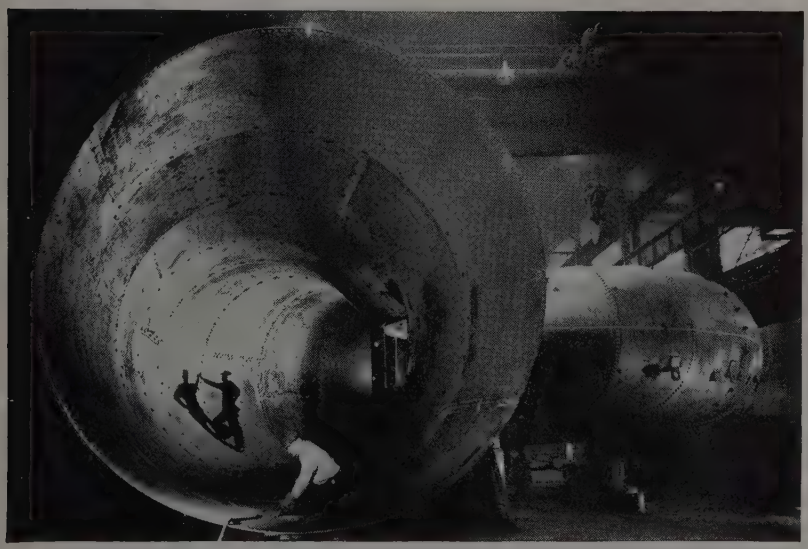
Recruiting engineers for the Graduate Training Course is one of our functions, and perhaps this is a good place to tell something about the course.

The course here is actually tailor-made for each man, and you help plan it. You can work it out to get concentrated training and experience in almost any phase of work that you want . . . even go on and get advanced degrees. Or, like so many of us, you may use it as an opportunity to get experience with many phases of the Company's operations.

Industry's Broadest Range

There are over 75 training locations for Graduate Training Course engineers at Allis-Chalmers' Milwaukee Plant alone. They include research, design and sales application on a wide range of products such as motors and generators, crushing, cement and mining machinery, steam and hydraulic turbines, centrifugal pumps, transformers, electronic equipment and milling machinery.

This is a 7 ft. x 8 ft. x 250 ft. rotary lime sludge kiln. Allis-Chalmers is also an important supplier of kilns to the cement industry.



Giant spiral casing for hydro power project is one way of showing that Allis-Chalmers can build them big.

That's only part of it. You can go into the shops and manufacturing end of the business—work in planning and production control, personnel, time study, wage determination and labor relations. Or, there's laboratory and research, purchasing, advertising, sales training, export sales. Somewhere during the two-year course you're going to get a start in the work that suits you best. If you have the stuff, opportunity is going to come your way.

If you'd like more information about the Graduate Training Course, stop in for a visit at your nearest Allis-Chalmers district or regional office—or write for literature.

ALLIS-CHALMERS

Allis-Chalmers Manufacturing Company, Milwaukee 1, Wisconsin

RESEARCH . . .

(Continued from Page 12)

pounds pressure; a half-dozen strips of lead sheathing being bent back and forth slowly, once an hour; another half-dozen being bent more rapidly, 10 minutes for each complete bend; and 108 strips hung with varying weights to study long-time stretch.

From these tests, which include various alloys, come many valuable facts. Some of them surprise even Professor Dollins.

One of these surprises is on a rack which holds nine lead sheath specimens each ¼ *in.* wide and 10 *in.* long. On them 11 to 22 *lb.* weights have been hung since 1939. The stress is 300 to 800 *psi.* According to calculations the specimens should have broken nine years ago. One speciment—the tenth in the set—did. As for the remaining nine, Professor Dollins is patient, and when they do part he will have some more new facts.

Probing the Atom

The "heart" of a gold atom is three-tenths of a trillionth of an inch in diameter. Between the inch marks of a ruler you could line up 3,300,000,000,000 of them.

This measurement and other data which supports recent theories about the atomic nucleus were reported by a team of University of Illinois scientists.

Gold was one of the elements used in their research because it has a large nucleus. Their findings about its size and about distribution of the electrical charge within it are helping science to a clearer picture of how matter is organized. They also made similar studies with silver, copper, aluminum, and carbon, all of which have smaller atoms.

Some scientists have held that a nucleus consists of a shell of positively charged protons around a center of uncharged neutrons. Others have believed that the protons and neutrons are mixed together in a ball-shaped mass. The Illinois data supports the second theory.

For probing into the atom the men used a newly developed research tool, a beam of carefully controlled high-energy electrons from the University's 22-million volt betatron. They had it set at a precise 15.7-million volts, in contrast to roughly 2-million volts used elsewhere for earlier studies on this subject.

Conducting the experiments were Prof. Ernest M. Lyman, Prof. Alfred O. Hanson, Merril B. Scott, and Lawrence H. Lanzl. They presented their findings in a series of four papers.

Now they are looking forward to making similar studies with electrons from the University's new 340-million volt betatron, largest instrument of its kind in the world.

Astronomical Dust

Prof. Robert H. Baker, University of Illinois astronomer, has a dust problem, and the dust is 6,000 light years away, or thereabouts.

For more than 12 years, Professor Baker and other astronomers have been making a statistical study based on photographs of "the bright girdle around the sky" which is called the milky way. The chief object of the study is to determine the details of this system of stars which is in our vicinity.

Now the astronomers are into a lot of dust "out there." The dust dims and reddens the stars behind it—like the setting sun. Somehow the astronomers must find just where the dust is, and how much, and literally sweep it out of their problem with a scientific broom.

The U. of I. astronomer has been studying the Galactic system ever since joining the University faculty 28 years ago. In fact, he and his predecessor, Dr. Joel Stebbins, who was in charge of astronomy work at the U. of I. for 20 years, are the only men who have headed extensive research projects at the University observatory, built in 1896. Dr. Stebbins pioneered in use of the photoelectric cell for accurately measuring the brightness of stars. The earlier cells he used were developed by the late Dr. Jacob Junz of the U. of I. physics department. The Kunz cells were known for their high sensitivity to light.

Although the main observatory once was an isolated structure, it has been overrun by rapidly spreading University buildings. It still is used by students intent on studying the moon and planets, but when Dr. Baker does his night-time photography work, he goes south of the campus to a smaller observatory located out-in-the clear on the University farms.

Why have Dr. Baker and his coworkers in this country spent years in star-gazing, concentrating on "our" milky way?

"There aren't many geniuses among us," the U. of I. professor replies. "Each does his job and hopes to contribute significant findings. It's a lot of fun, really, but what is more important, we would like to find out about the sort of place in which we're living. Others to follow will explore more deeply into the galactic system. So far, we have just reached the suburbs—and now we're getting into all this dust."

Amateur star-gazers everywhere are familiar with Professor Baker's book, *When the Stars Come Out.* His *Astronomy* is now in its fifth edition. He has written also, among other volumes, *Introducing the Constellations,* and *An Introduction to Astronomy.*

Some persons relax at the movies. Dr. Baker finds rest and enjoyment in "writing another chapter."

THEMES . . .

(Continued from Page 26)

must be carefully spliced together. Care should be taken to have the upper portion of the pile made of concrete to avoid decay to that part which is above low water table.

Long concrete button-bottom piles are now being driven for the first time in Mexico City for the newer buildings. These piles are cast in place in a corrugated shell which is inserted in a driving casing. At the bottom of the driving casing is a concrete plug which forms the bottom of the pile. After the corrugated shell has been filled with concrete the driving casing is withdrawn from the ground. This type of pile will keep the building from settling, but as the gradual settlement of the area takes place, it will leave the ground floor above the surrounding ground.

Although a variety of foundation methods have been tried with varying success, Mexico City's foundation problem hasn't been solved.

Practical Civil Engineering

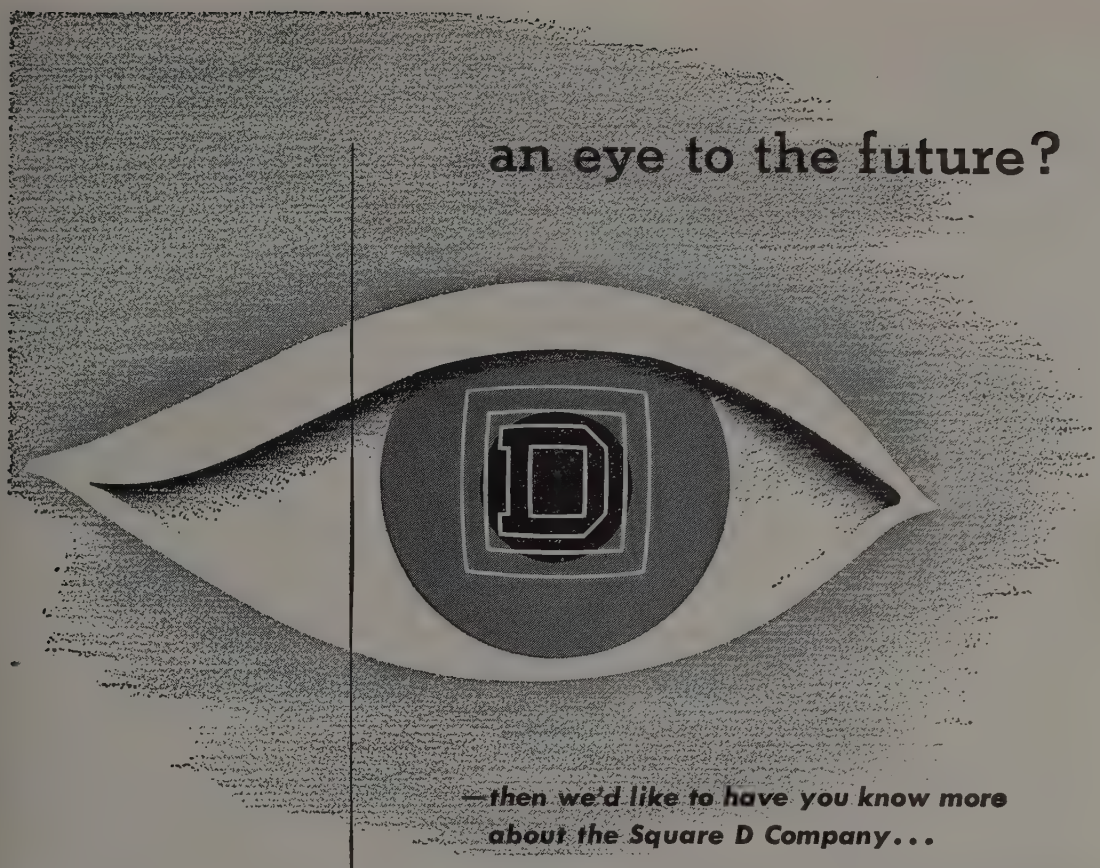
I have been going to school now for four years, and all that time has been wasted if you'd believe some people. It seems that the only thing that does any good is practical experience. You can't design a good shovel until you've dug ditches with one, and after that you don't need a college education to design the thing anyway, or so they say. The same way with highways, potato peelers, corset stays; you can't design them if you haven't had some experience with them. So, last summer, I got myself a job as a section hand on the Chicago and Northwestern Raliroad. Certainly, if a budding civil engineer could get practical experience anywhere, it was on the scenic C.&N.W.R.R., "route of the 400."

Well, I got my practical experience. For anyone majoring in shovel handling, I would strongly recommend the railroad. Believe me, nowhere else can you get such a wealth of experience in shoveling and other related arts. Experience of this type is also stimulating to the imagination. As you dig out ties, tamp ties, spike ties, carry ties, or mark ties, your mind is left free to curse ties and people that insist upon the value of practical experience.

Actually, I did learn some things

(Continued on Page 42)

an eye to the future?



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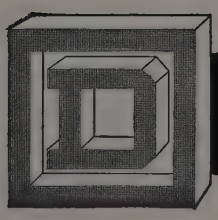

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INTRODUCING . . .

(Continued from Page 14)

project. This work of the NDRC was done by civilians chiefly for the Navy, who had a liaison officer attached to coordinate the activities.

Following his participation in this research work, Dr. Slichter returned to Harvard, graduating with a B.S. Degree in 1946. He went on to receive his M.S. in 1947 and his Ph.D. in 1949.

In the fall of 1949, Dr. Slichter came to the University of Illinois. Here he teaches physics 321 and 322 regularly plus physics 103 on the off semester. He also spends much of his time on research work in the general field of nuclear magnetic resonance (radio frequency and micro-wave). This field, known as spectroscopy, is quite new, and was opened up after World War II due to research by the Electronics Board during the war.

Dr. Slichter, who calls himself a "full time physicist," has no major hobbies, but instead finds various ways of using up his spare time. During the summer months he does research work for the Navy under contract.

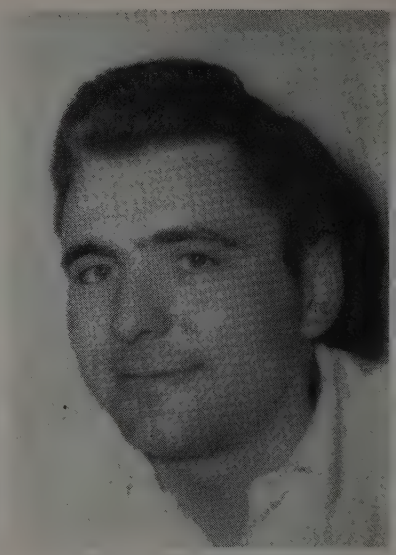
His reaction on winning the efficient instructor poll was "very pleased and kind of surprised." One must readily admit that Dr. Slichter, who is a member of Phi Beta Kappa and Sigma Psi national honorary fraternities, has had a very successful start in his physics career.

EDWIN B. CHRISTIANSON

Ed Christianson, a February, 1952, graduate and president of the Engineering Council, is a native of Elgin, Illinois.

After his graduation in February from the college of electrical engineering where he is studying communications and electronics, Ed plans to go into communications work. His career may not be immediately interrupted by Uncle Sam's "Greetings" in the way that will affect many of his fellow graduates, because he is a veteran of three years service in the Army. It was his service in the Signal Corps that first caused him to think seriously of communications as a career. After his discharge from the Army he entered the University of Illinois in the spring semester of 1948.

He is a graduate of Elgin High School, where he was an outstanding athlete, lettering in football, wrestling, and track. Immediately after his graduation from high school, he enlisted in the Army and after serving his three-



EDWIN B. CHRISTIANSON

year enlistment, enrolled at the University of Illinois.

He has been a busy man since entering the University of Illinois in 1948. Besides maintaining a high scholastic average in the college of engineering, he has been quite active in the Engineering Council, of which he is now president. He is also president of Delta Upsilon social fraternity and an active member of the IRE-AIEE. He wa vice-president of the Engineering Cour cil last year and chairman of las spring's Engineering Convocation. H has also served as the engineering rep resentative and the treasurer of the Careers Conferences.

Oxford and Cambridge may have their cricket matches, and Harvard and Yale may have their big football game; but Texas A. & M. tops them all. The Aggies have their own slide rule contest.

Every engineering freshman at A. & M. must take an engineering problems course. The top ten per cent of the students in this course are selected to compete in the annual Slide Rule contest. At the contest each participant is given sixty problems to do in fifty minutes. The problems are generally somewhat like this one: $\frac{(18.3\text{ft})\ (\sin 18°)}{\sqrt{0.43}\ (\tan 61°)}$. Both speed and accuracy are taken into account, so the winner is the man who gets the most problems right in the time allotted.

Get that saddle off the stove, Ma, you're too old to ride the range.

* * *

When they kiss and make up, she gets the kiss and he gets the makeup

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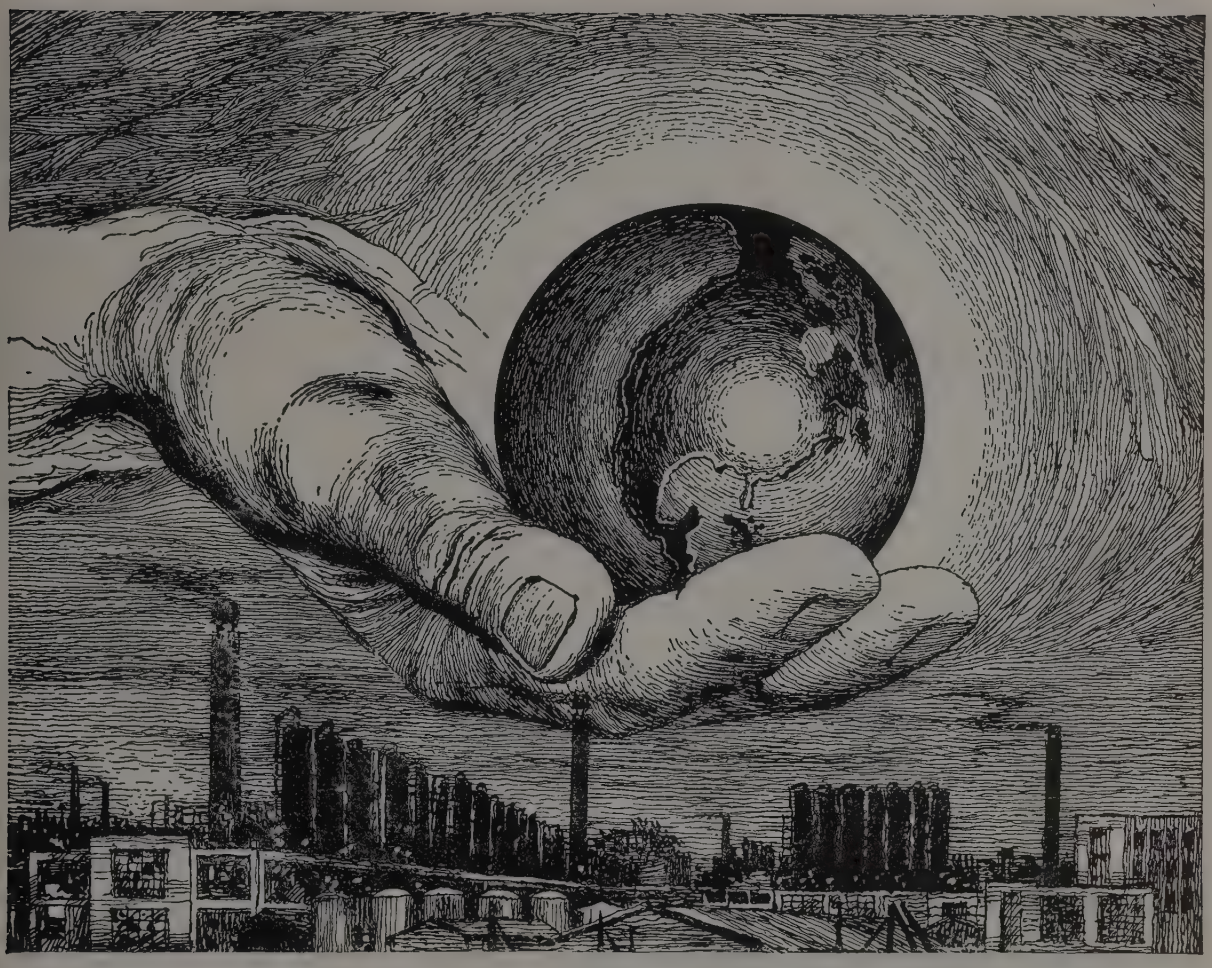

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Vision—75 Years Ago

Though the greatest advances have been made within three decades, the foundation for this progress was laid by the pioneering American chemists who 75 years ago had the vision to form the American Chemical Society. Their society has grown from a handful of members to well over 60,000—the world's largest professional scientific organization. The people of Union Carbide are glad to pay tribute to the American Chemical Society on its Diamond Jubilee, and on the occasion of the World Chemical Conclave.

Union Carbide Grows With Science

Chemistry and the related fields of physics and metallurgy have long been major interests of Union Carbide. The application of these sciences to producing new and better materials has been the backbone of UCC's growth.

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SKIMMING . . .

(Continued from Page 2)

physical and chemical make-up of stars will be determined. The optical system will also be capable of analyzing stars of low magnitude.

minute miracle gage

A simple gaging device the size and thickness of a postage stamp can measure minute or extremely heavy loads, dimensional changes of a millionth of an inch, or temperature changes ranging near absolute zero to 1600 degrees above.

The simple device consists of a wire one-third the thickness of a human hair which is wound back and forth, then coated with cement. If the gage is distorted so that the wire is stretched or contracted, its resistance to passage of an electric current is varied. Measurement of the variation tells the exact amount of stretch. The instrument will accurately measure a dimensional change of a millionth of an inch in one inch of length.

One application of the gage is in testing military jet engine blades while they are in operation. The gage is cemented to the blade, a current passed through it, and the engine is run. Any bending of the blade stretches the wire and changes its conductivity, which is then registered on a meter. Thus the engineers can tell exactly what is happening to a spinning blade while the engine is in operation.

new methods in welding

Arc welding, a process of primary importance in fabricating defense materiels such as tanks, planes, and ships, has been greatly improved since World War II by the addition of new methods.

One new method requires the use of inert helium or argon gas. These shield the welding arc and the white-hot area of the weld from the destructive effects of oxygen. Thus, it is possible to weld faster without "burning" the metal and weakening the joint.

In one production line using this method, *¼-in.* thick bronze plates are welded together with the machine closing 18 *ft.* of seam per minute. In another case, using a tungsten electrode shielded by an inert gas, stainless steel tubes only 1/16th *in.* in outside diameter were welded. After welding, the tubes withstand 500 *psi* of internal pressure.

A new method of soldering glass to metal, developed by GE scientists, makes the bond stronger than the glass itself. The method can also be used to solder metal to ceramics and carbon.

The glass and metal areas to be soldered are painted with a thin layer of titanium hydride, and solder is placed upon both areas. The parts are placed together and then heated under a vacuum.

When the temperature reaches about 900°F the titanium hydride decomposes. This causes the solder, which has already become molten, to adhere to the titanium-painted areas of both the glass and metal. A strong, tight bond is formed upon cooling.

By using soft metal solders, it is possible to subject this glass-to-metal seal to rapid temperature changes without danger of cracking, despite the wide difference in temperature expansions between glass and metal. This is possible because the differences in movement are absorbed by the solder.

photographs by sound

Visitors at G.E's recent petroleum industry electrical show were snapping self-portrait photographs by means of sound.

The photography operation is part of a demonstration of the use of sound tones for remote control by engineers of G. E's Electronics department.

The photographs are taken by using a tone sent out at a certain frequency by a tone generator when the subject-photographer presses a button.

The sound is carried the length of the exhibit booth via a microwave transmitting and receiving unit and is picked up by a selective amplifier attuned only to the particular frequency of the tone.

The amplifier, in turn, produces energy which operates the switch controlling the camera lens and flash attachment.

The entire operation, from the pressing of the button to the clicking of the camera shutter and the flash of the bulb, takes only a fraction of a second.

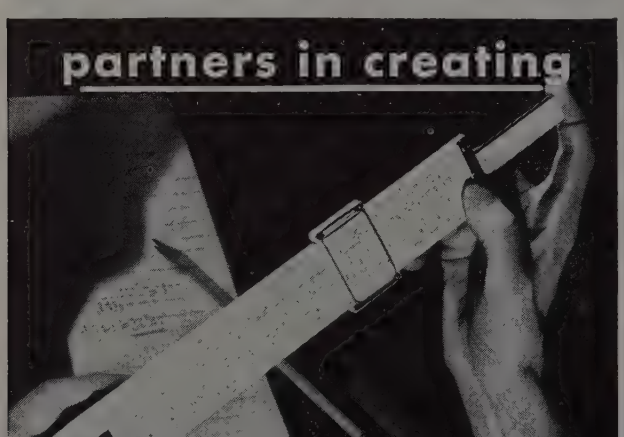
Engineers said the remote control by tones system can be used in wireless remote control of motors, valves, gates, and doors.

Equipment thus far developed uses a tone generator to produce tones much like notes of a flute. By using combinations of these tones, the equipment can control up to 900 separate operations at distant points.

sawdust for cattle

Sawdust may some day be a practical food for cattle. Experiments conducted show that irradiation with high-voltage electrons, or cathode rays, makes part

(Continued on Page 40)



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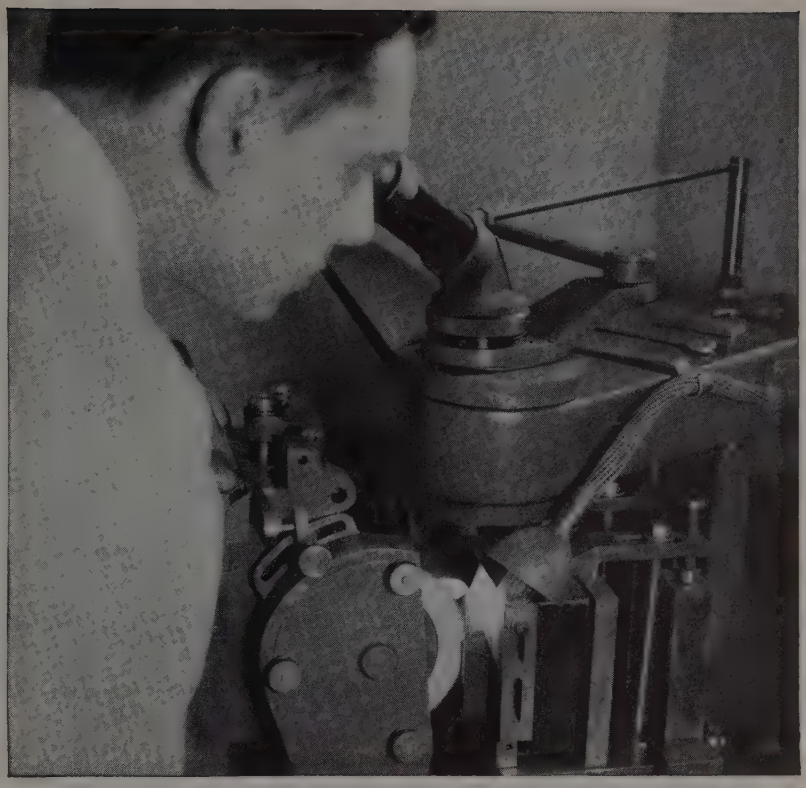
Who Is He?

- ☐ *a metallurgist*
- ☐ *an expert toolmaker*
- ☐ *a laboratory technician*



If you checked "toolmaker", you know your way around in a machine shop. He's grinding the contour of a carbide-tipped flat form tool on an optical-type precision grinder equipped with a Norton Diamond Wheel.

Facts You Should Know

One of the reasons for the industrial edge the United States has over other countries is its leadership in the use of cemented tungsten carbide tools. With them, American industry has speeded up mass production.

Cemented carbide tools are so hard that they cannot be machined in their ultimate form by any known metal tool. So, they must be shaped by grinding with abrasive wheels.

Diamond wheels have become the accepted type of abrasive wheel for precision grinding operations on cemented carbides. Their exceptionally fast and cool cutting action and extremely low rate of wear result in economically low grinding costs.

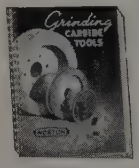
Norton Diamond Wheels

Norton Company pioneered in the development of diamond wheels in this country, bringing out the first Resinoid Bonded Diamond Wheel in 1934. This was followed 5 years later by the durable Metal Bonded Diamond Wheel. And in 1945, came the Vitrified Bonded Diamond Wheel, a development of the Norton research laboratories.

Today, the Norton price list for Diamond Wheels and Hones contains about 1000 items, ranging in list price from $17.70 to $2,877.35, depending on the size of the wheel and the diamond content.

Think It Over!

Because Norton Company is dedicated to "making better products to make other products better," Norton Research is always looking ahead. To the young technical man, such a progressive attitude promises an interesting future.



Free Handbook On Grinding Carbide Tools describes in detail how Norton Diamond Wheels are used to recondition and sharpen cemented carbide tools and cutters rapidly and economically. Write for a free copy.

Joseph C. Danec, B. S. Ch.E., Lafayette College '39, examines a diamond wheel section with Bausch & Lomb Research Metallograph in connection with his work on the development of Norton Metal Bonded Diamond Wheels.

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COLD WAR . . .

(Continued from Page 24)

temperatures has been, and still is, a time-consuming operation. Ordinary thermometers are practically useless. Mercury freezes at 39°F below zero, alcohol a little further down. The constant-volume helium gas thermometer, to which corrections are applied to secure conformity to the ideal gas scale, is acceptable all the way down to 1°A. Using this as a fundamental standard, more convenient working thermometers are usually prepared. Vapor pressure thermometers are used wherever possible. Resistance thermometers of platinum, phosphor-bronze, or other metals and thermocouples are also widely used.

For temperatures below 1°A, reliance upon measurements of the magnetic susceptibility of paramagnetic salts is general. It is assumed that for these substances Curie's law is valid. This is: $X=C/T$, where X is the susceptibility and C is a constant. It is possible to correct this arbitrary scale to the thermodynamic scale of temperature when sufficient magnetic and heat capacity data are available.

Low Temperture Phenomena

Perhaps the most fascinating part of low temperature study is the effect of very low temperatures on certain substances. The properties which have been observed to vary with the temperature are the electrical resistance, the magnetic susceptibility, and the specific heat.

The electrical resistance of a large number of metallic elements and alloys falls to zero at very low temperatures. An electric current, once started in a superconducting circuit, continues to flow without help from an electric cell or other source of potential. Once the temperature rises above a critical point, however, the current ceases to flow.

Actually, superconductivity has been put to work in a limited way. This is in a sensitive heat measurer known as a bolometer. This heat-detecting device, built around a superconducting responsive element, can be used to detect heat waves from unseen smoke stacks of warships and from the exhausts of airplanes.

Without a doubt, the most unusual acting element at very low temperatures is helium. At very close to absolute zero, helium exists in two forms, known as helium I and helium II. The second of these has many strange properties, including the ability to separate itself from the first by climbing up and over the walls of the container. This uphill flow has been clocked at 25 *mph*. As yet, there is no theoretical explanation for this apparent defiance of gravity.

The liquid helium of 2°A conducts heat a thousand-fold better than copper does at room temperature. It has the highest thermal conductivity known t man. Liquid helium at this temperatur has no viscosity and flows without drag If one were to stir up some of thi liquid helium in a cup, for example, i would continue to swirl around foreve (providing it didn't evaporate). For thi reason, it is called superfluid.

Practical Applications

As a direct result of the extensiv research done in the field of low tem perature physics, many practical appli cations have been developed. For ex ample, research has brought about house hold refrigeration and the mass produc tion of pure oxygen and nitrogen fron liquid air. Liquid oxygen, in turn, i used for oxyacetylene torches and as constituent of the fuel of V-2 rockets.

Refrigerated crystals, free of interna noise, will pick up radio signals fa fainter than the threshold of a heate radio tube.

A tiny rocket motor developed at th cryogenic laboratory of the Ohio Stat University uses liquid hydrogen as fuel, and liquid oxygen as the oxidizin agent. Its exhaust jet nozzle emits gase at a speed of around 15,000 *mph*. Thi vital research may lead to the develop ment of a fuel powerful enough to pro pel a rocket far out into space.

All in all, low temperature studie have led to better gasoline, stronge steel, longer-wearing rubber, improve glass and more efficient processes in score of different industries.

How Far Down?

The question that naturally arises a this point is whether the magnetocalori effect may be used to attain absolut zero. The experimental evidence seem to indicate that it is impossible. In fac scientists are so sure of this fact, the have based the Third Law of Thermo dynamics upon it. It reads: *It is impos sible by any procedure, no matter hov idealized, to reduce any system to th absolute zero of temperature in a finit number of operations.*

Although most elementary textbook in physics state that at absolute zer all molecular activity ceases, scientist have found nothing of the kind. Atom and molecules stop their individualisti operations and instead act like a per fectly drilled chorus. Consequently, on must adopt the following notion: abso lute zero is that state of a substance a which it has a minimum of energy, no an entire absence of energy.

Low temperature physics has on characteristic that makes it rathe unique, today. The United States an its Western allies readily exchange in formation with the USSR concernin problems and observations encountere in the low temperature domain. Th only "cold war" they fight is the on against Nature.

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SOCIETIES

(Continued from Page 16)

cated at 112 East Daniel in Champaign. Chapter officers for the coming year are Dave Donnelly, president; Ken Walter, vice-president; Gerald Giffin, treasurer; Bob Schrader, corresponding secretary; Harlan Schone, recording secretary; Dick Brown, commissary; and Harold Zahn, house manager. The chapter adviser is Professor L. D. Walker of the GED department.

SIGMA PHI DELTA

"The promotion and advancement of the engineering profession and engineering education; the installing of a great spirit of cooperation among engineering students and their organizations; the inculcation in its members of the highest ideals of Christian manhood, good citizenship, obedience to law, and brotherhood; and the encouragement of excellence in scholarship" is the objective of Sigma Phi fraternity. The motto: "Pro Bono Professionis," which, translated from the Latin, means, "For the Good of the Profession," further bears out the objectives of this International Social Fraternity of Engineers.

Alpha Chapter of Sigma Phi Delta fraternity was founded at the University of Southern California on April 11, 1924, making Sigma Phi Delta one of the youngest of the national fraternities. Delta Chapter of Sigma Phi Delta was established at the University of Illinois on January 25, 1928.

Delta Chapter of Sigma Phi Delta fraternity is located at 1103 West Illinois street, Urbana, Illinois. Members of Sigma Phi Delta may be found in almost all branches of engineering including chemical, architectural and agricultural engineering. Likewise, members of this fraternity may be found in most of the engineering activities, including Engineering Council, *The Technograph*, Sigma Xi, and most of the other engineering societies and honoraries.

The founders of this fraternity combined the functions of all three types of fraternities—honorary, professional, and social, into one fraternity. The social life of the engineering student is limited by the amount of time he has to devote away from his laboratories and theories. Therefore, a social program which tends to make a well-rounded individual, but which does not occupy too much time is the aim of the chapter. The members of Sigma Phi Delta participate in the intramural activities sponsored by the IF Council and support all the other activities and plans of the Council.

Faculty members of Sigma Phi Delta fraternity are Professors Babbitt, Crandell, Knight, Straub, Tuthill, and Wiley. There are also alumni in teaching and research positions on the faculty. Delta Alumni of Sigma Phi Delta has been very active and cooperative in the support of the active chapter. The alumni chapter continues the ties of brotherhood after the members graduate and leave the campus. There are approximately 2000 alumni members of Sigma Phi Delta fraternity throughout the engineering profession.

Walking with a friend one day, a professor passed a large fish shop where a fine catch of codfish with mouths open and eyes staring were arranged in a row. The prof suddenly stopped, looked at them, and clutching his friend by the arm, exclaimed: "Heavens! That reminds me, I have a class in EE this hour."

Drunk: "Loowit that shign."
Drunker: "Whazzit shay?"
Drunk: "Say 'Ladies ready-to-wear clothes'."
Drunker: "Well, ish about time."

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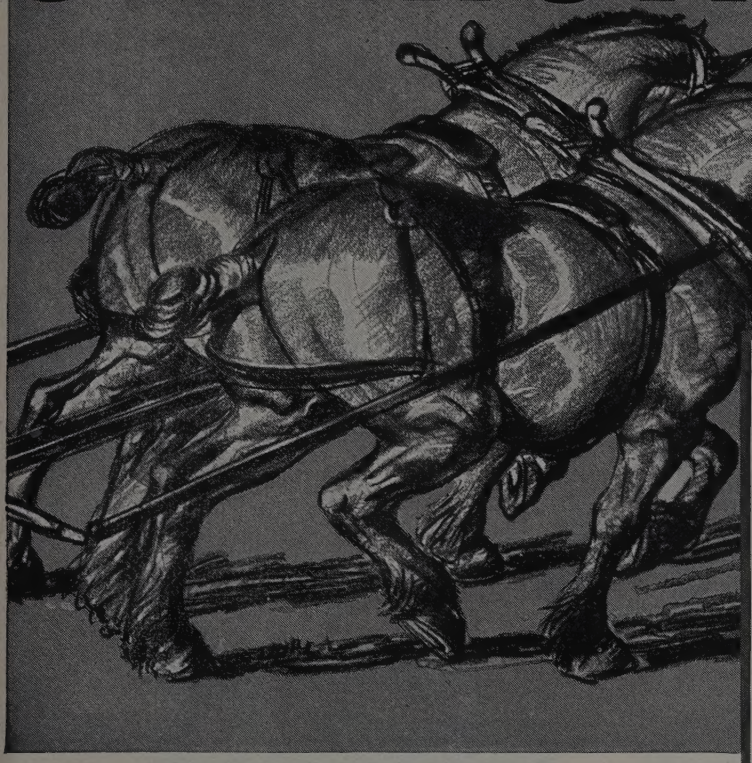
STRENGTH is vital



STRENGTH
is vital in pipe for city streets

CRUSHING STRENGTH

The ability of cast iron pipe to withstand external loads imposed by heavy fill and unusual traffic loads is proved by the Ring Compression Test. Standard 6-inch cast iron pipe withstands a crushing weight of more than 14,000 lbs. per foot.

BEAM STRENGTH

When cast iron pipe is subjected to beam stress caused by soil settlement, or disturbance of soil by other utilities, or resting on an obstruction, tests prove that standard 6-inch cast iron pipe in 10-foot span sustains a load of 15,000 lbs.

SHOCK STRENGTH

The toughness of cast iron pipe which enables it to withstand impact and traffic shocks, as well as the hazards in handling, is demonstrated by the Impact Test. While under hydrostatic pressure and the heavy blows from a 50 pound hammer, standard 6-inch cast iron pipe does not crack until the hammer is dropped 6 times *on the same spot* from progressively increased heights of 6 inches.

BURSTING STRENGTH

In full length bursting tests standard 6-inch cast iron pipe withstands more than 2500 lbs. per square inch internal hydrostatic pressure, which proves ample ability to resist water-hammer or unusual working pressures.

Be doubly sure when you specify pipe for mains to be laid under city pavements. Sure that it effectively resists corrosion. Sure, also, that it has the four strength factors, listed opposite, that pipe must have to withstand beam stresses, external loads, traffic shocks and severe working pressures. *No pipe, deficient in any of these strength factors, should ever be laid in paved streets of cities, towns or villages.* Cast iron water and gas mains, laid over a century ago, are serving in the streets of more than 30 cities in North America. These attested service records prove that cast iron pipe not only assures you of effective resistance to corrosion but all of the vital strength factors of long life and economy.

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CAST IRON PIPE SERVES FOR CENTURIES

SKIMMING . . .

(Continued from Page 32)

of the sawdust digestible, by organisms in the cow's stomach. A cow is able to utilize pure cellulose (such as cotten) as food. Wood consists largely of cellulose, combined with another compound, called lignin, in which combination it is indigestible.

The cathode rays make the cellulose available. Bacterial action in the rumen, the first of the cow's four stomachs, is able to convert the cellulose into several other compounds. These can be absorbed in the animal's intestines.

Basswood was used in the experiments, both in the form of sawdust and small wafers. A modification of the million-volt-X-ray unit developed by G. E. scientists for medical and industrial use served as a source of electrons.

Ordinarily the stream of electrons, accelerated to million-volt energy in a series of steps, hits a tungsten target at the end of the tube, generating a beam of X-rays. When used for cathode rays, a thin metal window replaced the target and the electrons themselves emerge. Various materials may then be placed in the beam to study the effects.

liquid impact

Ordinary water in which extremely fine abrasive dust is suspended may be used for producing high finishes on both metal and non-metallic products.

Abrasives as fine as talcum powder and even finer are used, suspended in a liquid (usually water and a corrosion preventive) and the liquid is driven against the part to be finished by high pressure air. Impact of the particles removes minute amounts of metal from the surface and leaves it clean and with an attractive appearance.

Actually, the surface after liquid impact blasting is covered with millions of microscopic "pockets." On working surfaces, these hold oil and improve the operation of the part and its life, giving the surface a pleasing, non-glare appearance.

It is also useful on instruments and tools. Cutting tools last longer if they have been liquid-impact blasted. The operation has the same effect as if a machinist carefully honed the cutting surface by hand.

Besides small machines for use in tool rooms, machines have been built to automatically remove heat-treat scale and improve the finish of ring and pinion gears.

Newlyweds.

He: "Who spilled mustard on m waffle?"

She: "Oh, John! How could yo This is lemon pie."

* * *

He: "I suppose you dance."

She: "Oh, yes! I love to."

He: "Fine, that's better than dan ing."

* * *

And then there's the fellow wh walked into a bar optimistically, an left misty optically.

* * *

I serve a purpose in this school
On which no man can frown—
I quietly sit in every class
And keep the average down.

* * *

Freshman: "I have a sliver in m finger."

Sophomore: "Been scratching yo head?"

* * *

Professor: ". . . and that conclud my lecture. Now everybody poke h neighbor so that the sound of the be won't shock him!"

* * *

Jungle love is where a couple ju monkey around.

Buffalo's Largest Store Air Conditioned throughout with Frick Refrigeration

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Sattler's Department Store, covering most of a large city block, serves up to 150,000 people in a single day. The giant store is cooled in hot weather with ten Frick ammonia compressors using 920 horsepower. Installation by Mollenberg-Betz Machine Company, Frick Sales Representatives at Buffalo, N. Y.

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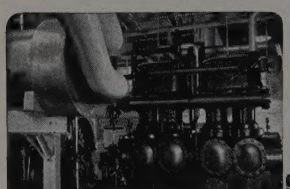

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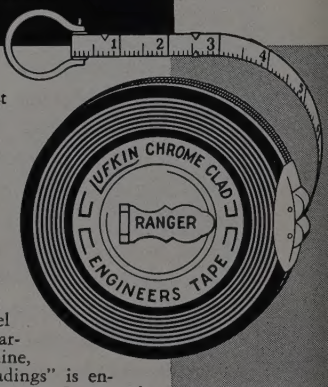

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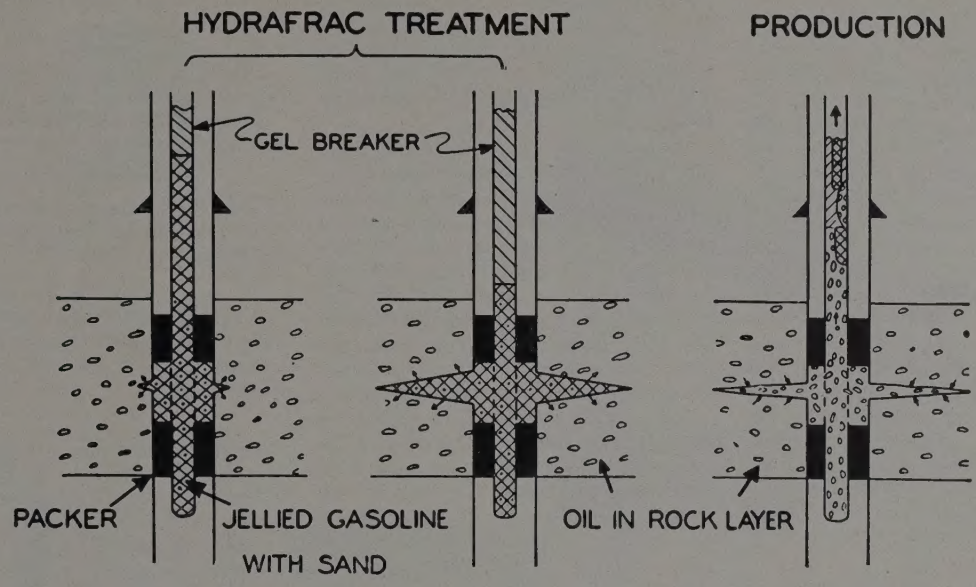

How "Jellied Gasoline" puts played-out oil wells back on their feet

THE PROBLEM of "rejuvenating" wells has become more and more urgent as tremendous civilian and military demands for petroleum products have continued to mount. A new hydraulic fracturing method has now passed the test of use on more than 3,000 wells in the field as the best way to get more oil from sources that have stopped producing.

Essentially, the new "Hydrafrac" method consists of two steps. First, a viscous liquid containing sand, or other granular material, is injected into the well under high hydraulic pressure. This causes fractures, or extends fractures, from the well bore into the oil-bearing formation.

Second, the viscous liquid—usually crude oil or kerosene and Napalm, the newly developed soap which was used in the war to make "jellied gasoline"—is broken down by injecting a gel-breaker solution. On release of the injection pressure, the resulting thinner solution flows back out of the fracture, now extended and widened, leaving the sand behind to hold the channel open for flow of oil into the well.

The Stanolind Oil and Gas Company of Tulsa, Oklahoma, Standard Oil's principal producing subsidiary, developed the Hydrafrac process after tackling the problem of "milking" old wells.

The process has been used both to obtain sustained production increases on "dried up" wells and to get a commercially practical flow from "tight" oil-saturated formations. Hydrafrac is now available, as a service, to the entire industry, helping it reach the higher and higher production goals of today.

This is an example of the interesting problems young engineers at Standard Oil face. And satisfaction in its solution is another instance of the rewards that come to the man whose research helps Standard Oil meet America's vitally important civilian and preparedness needs.

Standard Oil Company

910 South Michigan Avenue, Chicago 80, Illinois

STANDARD

THEMES . . .

(Continued from Page 28)

which might be valuable to a civil engineer. I doubt whether there is any kind of a job that doesn't offer some possibilities for learning. One thing of interest that I noticed was what could become of the engineer's work in the hands of the workmen. There must be thousands of blueprints drawn up every year only to be cast aside while the foreman does the work as he thinks it ought to be done. I worked for an old foreman who had been on the same job for the last twenty-five years. We were supposed to lay out a new high-speed curve. We had all the materials, including rolls and rolls of blueprints. I don't believe the old boy looked at them once. We laid out the curve under his direction and the trains seemed to run over it all right. Whether they would have run better if he had followed the blueprints I don't know, but it gave me something to think about anyway.

There is also a difference between what you read in the textbooks, and what actually happens on the job. For instance, the textbook tells you that the ties are tamped, dressed, and they carry such and such a load. Actually, though, the quality of a railroad bed is dependent on the skill and persistence of the men tamping the ballast under the ties. I've seen two pairs of men tamping alternate series of ties, one pair tamping solidly and the other pair just covering up the whole so it would look good. This undobutedly gave the worst riding track possible.

Probably the most important thing that anyone learns through working on the job is the worker's outlook. No man could be a successful supervisor without having a little insight into the worker's psychology. I learned things about the Taft-Hartley Law on the road that I'm sure would be a great surprise to Senator Taft himself. Likewise I learned what makes men like one supervisor while they think another is "chicken."

All things considered, I guess the summer wasn't wasted—I earned a little money (not much), I got some nice, tough callouses, and I learned the big difference between theory and practice. But my real finding; the gem; the little golden drop of distilled wisdom which I extracted from my summer's work with pick and shovel was this: Get yourself some nice job in an air-conditioned office as far from the digging as possible, thinking up ways of putting wings on the freight trains so they won't need tracks to run on anyway.

"In some parts of India a wife ca be bought for $2. Isn't that awful!"

"Oh, I don't know; a good wife ma be worth it."

* * *

Student: "I don't like these picture they don't do me justice."

Photographer: "Justice—son, wha you need is mercy!"

* * *

Jill: "Got something in your eye?"

Jack: "No. I'm just practicing look ing through my thumb."

* * *

The E.E. truly spoke when he said "Electricity travels 11,600,000 miles minute, arriving just 59 seconds afte the town gossip."

* * *

Freshman German Student: "Wha is castor oil known as in Holland?"

Senior: "Old Dutch Cleanser."

* * *

What this world needs is a trans parent eight-ball so we can see wher we are going."

* * *

Overheard in the testing lab:

"Did you say your girl's legs ar without equal?"

"No, I said they knew no parallel.

When the country's largest railroad loudspeaker system was planned in the Baltimore and Ohio's yards near Chicago, the choice of cable to be used was a key factor. With 37 miles of underground cable involved, subsequent maintenance costs could conceivably be a major item if any but the best cable were to be used.

Okonite cable was chosen for this job because of its superior rubber insulation and the resistance of its Okoprene sheath to alkalis, acids, oils and other corrosive substances encountered in railroad yard installations. Today, 197 two-way loudspeakers, 50 paging speakers, a complete telephone and printing telegraph system, and an independent inter-communicating system between offices in the yard are operated over Okonite cables in this network.

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Tough jobs are the true test of electrical cable . . . and installations on such jobs usually turn out to be Okonite.

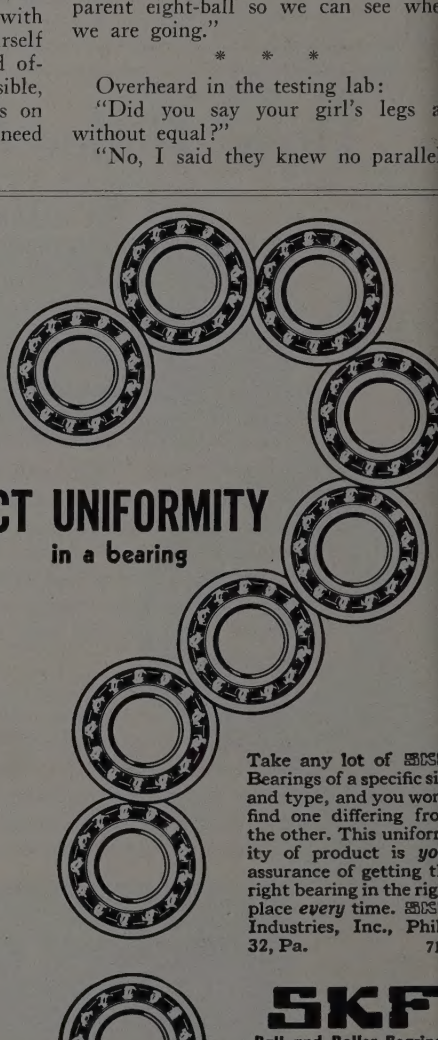
OKONITE *insulated wires and cables*

8783.

What is

PRODUCT UNIFORMITY

in a bearing



Take any lot of SKF Bearings of a specific size and type, and you won't find one differing from the other. This uniformity of product is *your* assurance of getting the right bearing in the right place *every* time. SKF Industries, Inc., Phila 32, Pa. 717

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Ball and Roller Bearings